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RETURN TO
Historical Research Division
ASI/HOA
Maxwell AFB, AL 36112

29 JUN 1989

# ROUGH DRAFT HISTORY OF DISCOV

VOL II

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AIR FORCE SYSTEMS COMMAND

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS ORGANIZATION (AFSC)
AF UNIT POST OFFICE, LOS ANGELES, CALIFORNIA 90045

REPLY TO ATTN OF: CSH/Mr. Piper

20 January 1972

SUBJECT: Miscellaneous Discoverer Historical Material

TO: HO/HOA
Maxwell AFB AL 36112

1. Furnished herewith are five volumes of old Discoverer historical material that may be of use to researchers:

a. Document History of Discoverer, Volume One (Confidential/Group 3).

b. Document History of Discoverer, Volume Two (Secret/Group 3)..

c. Rough Draft History of Discoverer, Volume One (Secret/Group 3), containing Narrative, Appendix A, Bioastronautics-Discoverer Board Report, 22 December 1959 and Appendix B, Launch Data Digest (a list of 78 Discoverer launches).

d. Rough Draft History of Discoverer, Volume Two (Unclassified), containing Appendix C, Biomedical Space Specimens Fact Sheet; Appendix D, Notes and Editorial Background for primate launch; Appendix E, News Release (approved for launch of primate); Appendix F, Photo History of Discoverer in part,

e. Rough Draft History of Discoverer, Volume Three (Unclassified), containing Appendix F (Cont'd) Photo History of Discoverer; Appendix G, Discoverer XIII Life Cycle (Presentation by 6594 Test Wing (Satellite); Appendix H, Narrative of launch and recovery of Discoverer XIV by Capt Harold E. Mitchell.

2. This material, together with Document History of WS 117L (1946 to Redefinition), three volumes; Document History of Program 461, one volume; Document History of SAMOS, three volumes; Document History of Agena, six volumes and Agena Flight History as of 31 December 1967, two volumes, constitute a complete documentary history of the Agena upper stage vehicle development, including its various space program applications and launch record.

3. This letter is classified ~~CONFIDENTIAL~~/Group 3, as it reveals the title of classified programs associated with the WS 117L program.

4. Separate AF Forms 310 are being furnished for the two Secret volumes.

Robert F. Piper
ROBERT F. PIPER
Chief, History Office

~~CONFIDENTIAL~~

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PRIDE IN THE PAST 25 FAITH IN THE FUTURE

# HISTORY OF DISCOVERER

Prepared under the provisions of Air Force Regulation 210-3 and Air Force Systems Command Supplement No. 1 thereto as part of the United States Air Force Historical Program.

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FOR DRAFT HISTORY OF
DISCOVERER

## HISTORY OF DISCOVERER

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Appendix D, Notes and Editorial Background for Primate Launch
May be found in Volume 2

Appendix E, News Release (Approved for release after launch of primate)
May be found in Volume 2

Appendix F, Photo History of Discoverer (Photographs and Captions as published by Information Office) May be found in Volumes 2 and 3

Appendix G, Discoverer XIII Life Cycle (Presented by 6594 Test Wing (Satellite) (A.R.D.C.) Sunnyvale, California) May be found in Volume 3

Appendix H, Untitled /Narrative of launch and recovery of Discoverer XIV by Capt Harold E. Mitchell as told to Robert Cahn/ May be found in Volume 3

ROUGH DRAFT

# HISTORY OF DISCOVERER

Discoverer was designed as a program to use a large satellite vehicle capable of carrying diverse payloads in either satellite or space probe operations. The discoverer is composed of the satellite vehicle, the Thor booster (modified to function as the first stage thrust device for the Discoverer vehicle), launch facilities, tracking facilities, and a complex communication and data processing network with related facilities.[1]

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[1] Discoverer Development Plan, 30 Jan 59, p I-2-1.

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(C) (Gp3) On 1 April 1957, after AFBMD had launched the first Thor on 25 January 1957, the Ramo-Wooldridge Corporation proposed use of IRBM (Thor) as first stage or booster for multi-stage vehicles.[2]

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[2] Study, Ramo-Wooldridge, 1 Apr 57, subj: Proposed Use of IRBM as Booster for Multi-stage Vehicles.

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However, Russia had launched Sputnik I before Headquarters, USAF became interested in an early space vehicle capability and considered Thor as a cheaper and more available booster. When the Air Force presented the Advanced Reconnaissance System briefing to the Armed Force Policy Council on 5 November 1957, the Air Force recommended use of three available Thor boosters. The immediate result was the Able Program. RAND had undertaken a feasibility study or a reconnaissance satellite system that would provide an early and continuing photographic reconnaissance capability in augmentation of the WS 117L program which RAND published on 12 November 1957.[3]

(C gp3) The system RAND proposed differed substantially from the WS 117L concept under development. The following is quoted from the RAND Report:

> The proposed system used a spin-stabliized payload stage.
>
> It uses a transverse panoramic camera of essentially conventional design, fixed to spin with the final stage, which scans across the line of flight.
>
> The entire payload stage is recovered.
>
> The system uses a 12-inch camera, carrying 500 feet of 5-inch wide film. The extremely short exposure time--1/4000 sec--eliminates the need of attaining a precise altitude, exact image speed synchronization, difficult performance characteristics, and related problems. It will provide sharp photographs of about 60-ft ground resolution. Each exposure, covering some 300 miles across the line of flight, will photograph some 18,000 sq mi. The 500-ft

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[3] U. S. Air Force Project RAND Research Memorandum An Early Reconnaissance Satellite System, 12 Nov 1957 (RM-2012)

> roll will cover some 4,000,000 sq mi (almost half the S.U.) and show major targets, airfields, lines of communication, and urban and industrial areas. This satellite could weigh about 300 lb and be placed in a polar orbit at 180 ± 35 miles altitude by a combination of rockets such as Thor plus second stage Vanguard plus a third stage small solid rocket similar to the Vanguard's third stage. A one-day operation is envisaged, with recovery by command firing of a braking rocket on the 16th pass, so as to impact in a predictable ocean area.

RAND proposed the booster combination would be the "Thor IRBM and the second stage of Vanguard, with a small solid rocket, similar in principle to the third stage of Vanguard, to provide a final orbital increment."[4]

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[4] RAND Report, An Early Reconnaissance Satellite System, 12 Nov 57, (RM-2012) pp iii, 15.

---

(C/Gp3) Lockheed Aircraft Corporation incorporated the RAND's concept for early Thor-boosted reconnaissance flights in its WS 117L Development Plan for Program Acceleration published 6 January 1958. The development plan also discussed the "problems of terminal re-entry and recovery of a photographic satellite."

Representatives from the WS 117L Program Office, the Director of the Ballistic Missiles Center Project Office, and Lockheed Aircraft

Corporation met on 14 January 1958 to discuss the plan for acceleration of the WS 117L program. As a result of the meeting, AFBMD awarded Contract No. AF 04(647)-181 to the Lockheed Missile and Space Division on 25 January 1958, calling for four flights scheduled for October, November and December 1958, and February 1959.[5]

Mr. Roy Johnson, Director of Advanced Research Projects Agency (ARPA), cancelled the reconnaissance aspects of the Thor-booster phase of WS 117L by memorandum on 28 February 1958 and authorized Secretary of the Air Force to use the Thor booster with a suitable second stage vehicle for experimental flights and recovery of laboratory animals.[6]

On 19 March 1958, the Lockheed Missile and Space Division Contract was re-oriented to include development of a recoverable capsule to accommodate a biomedical package, later referred to as a "life support system." The completed capsule was scheduled for readiness for flight test no later than 30 November 1958.[7]

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[5] BMC (MCPTA) Memorandum for the Record, 21 Jan 58, subj: Plan for Acceleration of the WS 117L Program; Bioastronautics-Discoverer Board Report, 22 Dec 59.

[6] OSD Memorandum for Secretary of the Air Force, 28 Feb 58, subj: Reconnaissance Satellites and Manned Space Exploration.

[7] Bioastronautics-Discoverer Board Report, 22 Dec 59.

(C) The New Horizon Development Plan, 1 July 1958, provided for ten Thor boosted flights, six of which were programmed for bio-medical flights. Early in August 1958, Mr. Johnson augmented the planned Thor-WS 117L vehicles by adding nine vehicles. The new firing schedule called for one each month beginning in November 1958 and two each month beginning in April 1959. Johnson's basic intent for utilization of additional vehicles was for bio-medical experimentation, although not at that time limited to biomedical use.[8]

(C) ~~After Johnson redefined the WS 117L program, he issued ARPA~~ Order No. 48-59 on 16 December 1958 requesting the Secretary of the Air Force continue the Discoverer program in behalf of ARPA, and to submit a financial plan so that a basis of division of funds could be determined.

(c/Ges) Air Force Ballistic Missile Division submitted the 30 January 1959 Discoverer Development Plan together with the Sentry Development Plan because the two programs were independent programs and "partial approval of either program will require reconsideration of both efforts." In

(S) addition the MIDAS Development Plan was based on the assumption that the proposed Discoverer and Sentry programs were approved in their entirety.[9] The plan reflected the Air Force-ARPA agreed funding levels and at the direction of Headquarters, USAF certain costs were not identified in the plan.[10]

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[8] Msg, AFCGM 54161, 6 Aug 58.

The Discoverer Development Plan program structure based on ARPA Order No. 17-59, 4 September 1958 with subsequent amendments* provided for 15 ARPA flights, 13 of which AFBMD would specify payloads and two of which ARPA would specify special payloads to be determined by ARPA.

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[9] Ltr, AFBMD (WDZW) to Comdr ARDC, 11 Feb 59, subj: WS 117L Program.

[10] Ibid.

* The Development Plan specified that "As the result of the advanced Research Projects Agency (ARPA) Order No. 17-59, dated 4 September 1958 with three subsequent amendments, the program structure was established to provide for fifteen . . . ARPA funded flights." The writer cannot interpret the order or amendments to have any bearing whatsoever on the Discoverer Program but as Colonel Frederic C. E. Oder stated in an Interview with Dr. Alfred Rockefeller, Jr., AFBMD Historian, on 17 January 1959, when Secretary of Defense transferred Sentry to ARPA a big period of confusion followed. Many decisions were made in conference that were never put into written policies.

On 16 February 1959, ARPA approved, in general, the program objectives and related funding for the Discoverer program as presented to ARPA on 4 February 1959 but particularly noted that the approval pertained to a 13 vehicle program.[11] ARPA approved the Development and Funding Plan, dated 30 January 1959, for Discoverer program on 24 March 1959 but again the approval pertained to the 13 vehicle program.[12] However, the Director of Advanced Technology, Headquarters, USAF, notified the Commander, Air Force Ballistic Missile Division on 27 April 1959 that "In accordance with agreements reached at conference held at Pentagon, 17 April 59, you are instructed to revise the Discoverer Development Plan to provide for a total of 25 flights during Calendar Years 1959 and 1960." The Director of Advanced Technology, Headquarters, USAF, advised that the revised plan should be submitted to Under Secretary of Air Force at earliest possible date.[13] The Air Force Ballistic Missile Division received the instructions pertaining to a revised plan on 27 April 1959, and one day later the revised development plan, under date of 30 April 1959, and the cover letter were ready for dispatch to Under Secretary of the Air Force Malcolm A. MacIntyre.[4]

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[11] Amendment No. 1, ARPA Order No. 48-59, 16 Feb 59.

[12] Amendment No. 2, ARPA Order No. 48-59, 24 Mar 59.

[13] Msg, AFDAT 59353, 27 Apr 59.

ARPA approved the plan on 20 May 1959 by Amendment Number 4, ARPA Order No. 48-59, and at same time increased fund availability from $104.3M to $121.9M. Amendment Number 5, ARPA Order No. 48-59, 23 June 1959, increased fund availability from $12.19M to $132.3M.

On 20 July 1959, when ARPA increased the Discoverer program to a 25-vehicle program, AFBMD had already made one launch attempt and had launched four Discoverer vehicles. Before the first attempt, though still in the test stage, all sub-systems were considered workable, and launch and tracking facilities were ready for use.

The overall system development was divided into seven of the twelve sub-systems earlier identified with WS 117L. (plus Subsystem L). The first Discoverer Development Plan (dated 30 January 1959) identified Discoverer sub-systems as follows:

Subsystem A - Airframe
Subsystem B - Propulsion
Subsystem C - Auxiliary Power
Subsystem D - Guidance and Control
Subsystem H - Ground-Space Communications
Subsystem J - Geophysical Environment
Subsystem K - Personnel
Subsystem L - Recovery System

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[4] WDD Routing Slip, R. W. Curtin to Gen Ritland, 29 Apr 59; Ltr, AFBMD, Col Richard D. Curtin for BrigGen O. J. Ritland, 1 May 1959.

(C/Gp-3) Subsystems A, B, C, D, and H were common to the Midas and Sentry/Samos programs though modified to accommodate the payload subsystems perculiar to the programs. Subsystem L was perculiar to Discoverer.

(C/Gp 3) Subsystems J and K were also common to Midas and Sentry/Samos programs.

Subsystem J, Geophysical Environment consisted of studies, equipments, both rocket-borne and satellite-borne, required to provide environmental data considered essential to insure and simplify the design of a successful Advanced Reconnaissance System. ~~This-su-~~ The subsystem also included the ground equipment required to maintain, service, calibrate and checkout prior to flight, the equipments described above. Insufficient data existed on geophysical environment to insure successful design and test of the satellite vehicle in the following areas: (1) Atmospheric density; (2) Cosmic radiation; (3) Thermal environment; (4) Meteor physics; (5) Solar ultraviolet radiation; and (6) Atmospheric composition.[15]

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[15] Discoverer Development Plan, 15 Jan 60.

5

Systems Requirement Number 5 dated 29 November 1954* directed the Air Force Cambridge Research Center (AFCRC) provide environmental data which "effect design and test, such as pressures, tempetures, atmospheric composition, solar radiation and propagation characteristics."

Systems Requirement Number 5 also directed AFCRC "prepare and implement geophysical research program based on utilizing test vehicles."

Systems Requirement Number 5 dated 17 October 1955 superseded the earlier Systems Requirement and in December 1955, AFBMD requested AFCRC to continue the support previously accorded the Advanced Reconnaissance System. AFBMD initiated Obligating Authority No. 57-16 on 25 January 1957 for transfer of $422,000. to Air Force Cambridge Research Center for continued research in the Subsystem J area.#6

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* Management Report, ARS, 31 Jan 57.

Subsystem J, developed as Project 1764 consisted of the following tasks as shown in RDB Project Card, 2 April 1957:

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* Document may be found in the WS 117L documents.

a. 39791 - Solar Radiation Program in Ultraviolet and x-ray Region for ARS. The task was accomplished through a combination of "in-house" and contractual effort. In April 1957 the contractual effort was being accomplished by Comstock and Westcott, Inc., under Contract AF 19(604)-1889. Other contractors contemplated at that time were University of Chicago, Chicago, Illinois, and Radio Corporation of America, New York, New York.

b. 39792 - Interplanetary Matter and Meteor Physics in Relation to ARS. The task was accomplished through a combination of "in-house" and contractual effort. In April 1957 the following named contractors were working on the task:

(1) Temple University under Contract AF 19(604)-1894
(2) Oklahoma A and M under Contract AF 19(604)-1908
(3) Smithsonian Observatory under Contract AF 19(604)1901
(4) Stanford Research Institute under Contract AF 19(604)-1892

c. 39793 - Atmospheric Density Determination at Altitudes of Artificial Earth Satellites. The task was being accomplished through "in-house" and contractual effort. In April 1957 the following named contractors were working on the task:

(1) University of Michigan under Contract No. AF 19(604)-1871

(2) University of Michigan under Contract No. AF 19(604)-18

d. 39794 - Thermal Radiation Program for ARS. In April 1957 the task was being accomplished through a combination of "in-house" and contractual effort. The only contractor was the University of Colorado under Contract AF 19(604)-1899 although additional contracts were contemplated.

e. 39795 - Rocket and Instrumentation Support. In April 1957 the task was being accomplished through a combination of "in-house" and contractual effort. The same type of effort was being carried on by AFCRC under Geophysical Research Directorate Project 7659 with contractors, some of whom were being considered for this task. The contractors being considered were:

(1) Aerojet - General Corporation

(2) Wentworth Institute

(3) Oklahoma A and M

(4) New Mexico A and M

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Subsystem K, Personnel - Air Research and Development Command System Requirement No. 5, dated 17 October 1955, directed the Air

Force Personnel Training Research Center to support the Western Development Division, ARDC, in preparation of a System Development Plan. ARDC Systems Development Directive No. 117L, 17 August 1956 assigned responsibility for the implementation and execution of the development plan to Headquarters ARDC, Western Development Division. Western Development Division, to the degree specified, and upon request, had the support of all ARDC Centers. Amendment No. 2, SSD No. 117L, added Project No. 8728 - Qualative Personnel Requirement Information for the Advanced Reconnaissance System. Implementation of Project No. 8728 was at the discretion of Western Development Division WS 117L Program Office contingent upon availability of necessary resources. WDD assigned development of Project 8728 to Air Force Personnel and Training Research Center, Lackland Air Force Base, Texas, for the "production of systematic information relevant to the personnel and training requirements of the total weapon system 117L development plan." Initially the project required both inservice and contract efforts. The contractor prepared information on subsystem development and equipment development and AFPTRC project officer provided consultation and technical monitoring.[17]

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[17] R&D Project Card, Personnel Operations Subsystem for the ARS (System 117L) (System 117L POSS), 2 Apr 57

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As shown in Subsystem Report, Project 8728, 2 April 1957, the tasks of the project were as follows:

a. Task 87151 - Implication of Design. The contractor was primarily responsible for the task under consultative and technical guidance of the AFPTRC Project Officer.

b. 87900 - Qualitative Personnel Requirements Information. The contractor's responsibility was to collect and assemble data for the production of reports "which will be phased with equipment design and development." The object of the task was to "provide manning document information, position descriptions, and personnel selection information regarding the total personnel subsyystem of WS 117L."

87152 - Training Programs and Procedures. The Project Officer's responsibility was to "make recommendations for the training program and training procedures to be used to obtain skills required by operator and maintenance personnel of the system."

87153 - Training Equipment Characteristics. The Project Officer's responsibility was to prepare report on training characteristics of required trainers and if applicable previous contractual effort could be used. The object of the task was to "identify the special training devices required for the WS 117L training program and define the characteristics of the indivisual trainers."

87154 - Proficiency Test Development. AFPTRC considered a contractor but as of April 1957 a contractor had not been selected. AFPTRC's responsibility was to monitor partial in-service effort by Personnel and Maintenance Laboratories, Lockheed Aircraft Corporation. The objective was to "provide valid tests of the job knowledge, skill, and achievement varity for measuring the progress and/or proficiency of operating and maintenance personnel."

87155 - Handbooks and Job Aids. In April 1957 the WS 117L program had not progressed sufficiently to provide details.

87156 - Training Equipment Testing. Same as Task No. 87155.

AFPTRC established a liaison office at WDD for the purpose of coordinating Qualative Personnel Requirements Information activities.[18]

Major Stanley Valcik of AFPTRC was active as the WS 117L QPRI Project Officer from July 1956 to August 1957. Major Harry L. Smith, QPRL Project Officer and Major Ben F. Hicks, Project Officer, AFPTRC, reported for duty as resident project Officers on 26 July 1957.[19] Soon thereafter ARDC initiated action to eliminate AFPTRC as a separate ARDC Center. Colonel Harry L. Evans, Requirements and Equipment Office, Deputy Commander, Weapon System, and Captain Anthony A. Gomes, Operations and Training Procedures Analysis Division, Directorate of Manpower and Training, Deputy Commander, Plans and Operations, attended a conference 14-15 November 1957, at Headquarters ARDC, on the elimination of the AFPTRC, and distribution of the AFPTRC functions and manpower spaces within the ARDC structure. It was agreed that AFBMD would provide Headquarters ARDC an organizational structure or distribution of

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[18] ARDC Weekly Activity Report, 4 Feb 57

[19] Memorandum for Colonel Terhune from Colonel Frederic C. E. Oder, 23 July 57, subj: AFPTRC Support of WDD System Development; Supplement to Monthly Officers Roster as of 30 Oct 57; DOI, WDSSA, 24 Apr 57, Organizational Symbols; List of WS 117L Project Office personnel, 17 Apr 58.

46 human factor spaces into the existing AFBMD organization, together with manning information such as functional area descriptions, rank and civilian grade spread; job titles, and job descriptions.[20]

Four spaces, 1 major, 1 captain, 1 GS-13 and 1 Secretary-stenographer were transferred to WS 117L Directorate effective February 1958. Major Harry L. Smith became Human Factors Project Officer and Captain Ben F. Hicks became Project Officer (QPRI).[21]

Effective 15 April 1958, Headquarters ARDC discontinued the Air Force Personnel and Training Research Center at Lackland Air Force Base, San Antonio, Texas.[22]

The first Discoverer Development Plan described Subsystem K - Personnel as follows:

> A personnel sybsystem exists whenever any other subsystem,

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[20] Memorandum for WDT and WDO, Col Harry L. Evans and Capt Anthony A. Gomes, 19 Nov 57, subj: Joint WDTN and WDOTA Staff Visit Report to Hq ARDC on Elimination of AFPTRC as a Separate Center of ARDC.

[21] Supplement to Monthly Officers Roster, AFBMD, as of 28 Apr 58; List of Personnel WS 117L Project Office, 17 Apr 58; Management File 3-4-6, Human Factors Functions & Spaces asgd AFBMD fr AFPTRC, 12 Jun 58

[22] SO No. 11, ARDC, 27 Feb 58

or the booster subsystem, requires the interaction of personnel. A properly designed personnel subsystem consists of the following components:

a. Human engineering to insure optimum man-machine compatability.

b. Determination of the kinds and numbers of personnel required to operate and maintain the associated hardware subsystem.

c. Training and training equipment required to obtain suitably trained personnel.

d. Appropriate personnel support in the form of technical manuals and other job aids.

Subsystem L - Recovery Subsystem:- Discoverer Development Plan, 30 January 1959, provided that Recovery Subsystem "consist of a Satellite-borne capsule, suitable payloads, and equipment that will collect and transmit data by telemetering and that will insure successful re-entry and recovery from orbit."

Following the Director of Advanced Research Project Agency, Mr. Roy Johnson's memorandum of 28 February 1958 in which Mr. Johnson cancelled the reconnaissance aspects of the Thor-boosted phase of WS 117L and directed the Air Force to use the vehicles for biomedical experiments, AFBMD amended Contract No. AF 04(647)-181 to include the development of a recoverable capsule to accommodate a biomedical package.

The Sentry Development Plan dated 15 September 1958, provided for a Subsystem L Biomedical Recovery Capsule as follows:

1. 1. Subsystem "L" Biomedical Recovery Capsule:

(1) The Biomedical Recovery Capsule program has three primary objectives. These are:

(a) To recover living specimens from orbital flight.

(b) To study the psycho-physiologic response of specimens to conditions of launch, orbit and recovery.

(c) To build experience and confidence in recovery techniques. These objectives will be achieved by the launching of five biomedical recovery capsules into orbit on WS-117L flights. The capsules will be separated from the parent vehicle and be recovered on either the 18th or 32nd pass and will be recovered south west of Hawaii. The biopackage will be airsnatched by C119-L aircraft assisted by RC 121 aircraft and Navy surface vessels.

(2) Two basic configurations will be used. These are:

(a) Mark I Biomedical Recovery Capsule. The Mark I capsule wwighs 195 pounds at launch including the 15 lb. biopackage. The biopackage itself includes the animals (four mice), their cage, pressure shell, food, water and oxygen supplies, environment control devices, sensors, amplifiers, batteries and recorders. The remaining weight of the Mark I is made up of structure, ablation material, retro-rocket, parachute, beacon and other recovery aids.

(b) The information gained from the Mark I experiments include acceleration, noise, vibration, cosmic radiation effects, total pressure and gas storage measurements, temperature and animal viability.

(c) The Mark I capsule will be on orbit for 18 passes (24 hrs) and will be recovered on the 18th pass.

(3) Mark II Biomedical Recovery Capsule. The Mark II capsule will weigh approximately 279 lbs at launch, including the 57 lb. primate) the restraint devices, psycho-operant devices, pressure shell, food, water and oxygen supplies, environment control devices, sensors, amplifiers, camera, batteries and recorder. The remaining 222 lbs. is composed of structure, ablation, retro-rocket, parachutes and other recovery aids.

(a) The information gained from the Mark II experiments include all those mentioned for the Mark I, plus camera coverage, additional environmental measurements, several physiological measurements such as pulse, temperature, electro-cardiograph, etc. and a reasonably sophisticated psycho-operant device. The telemetered records of annual performance in conjunction with pre- and post flight testing should provide considerable information regarding the effects of prolonged weightlessness.

(b) The Mark II capsule will be in orbit for 32 passes (48 hrs) and will be recovered on the 32nd pass.

See Figure I for a diagram showing the WS 117L Bio Med Vehicle. Figure 2 shows a diagram of Discoverer II.

On 25 November 1958, Mr. Johnson directed the Commander, ARDC, to revise "that portion of the Discoverer test series which deals with biomedical payloads. Of the five originally programmed launchings, it is now planned to eliminate two of the small primate shots. This leaves two mouse containing payloads and one small primate payload."[23]

---

[23] Msg, RDQGW-11-39-E, 26 Nov 58.

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ARDC reassigned two vehicles formerly assigned to the biomedical payloads to the launching schedule requested in ARPA Order No. 17, as amended.[24]

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[24] *Ibid*.

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On 5 December 1958, Mr. Johnson revised the biomedical payloads for Discoverer to provide for one successful primate recovery up to a

[redacted]

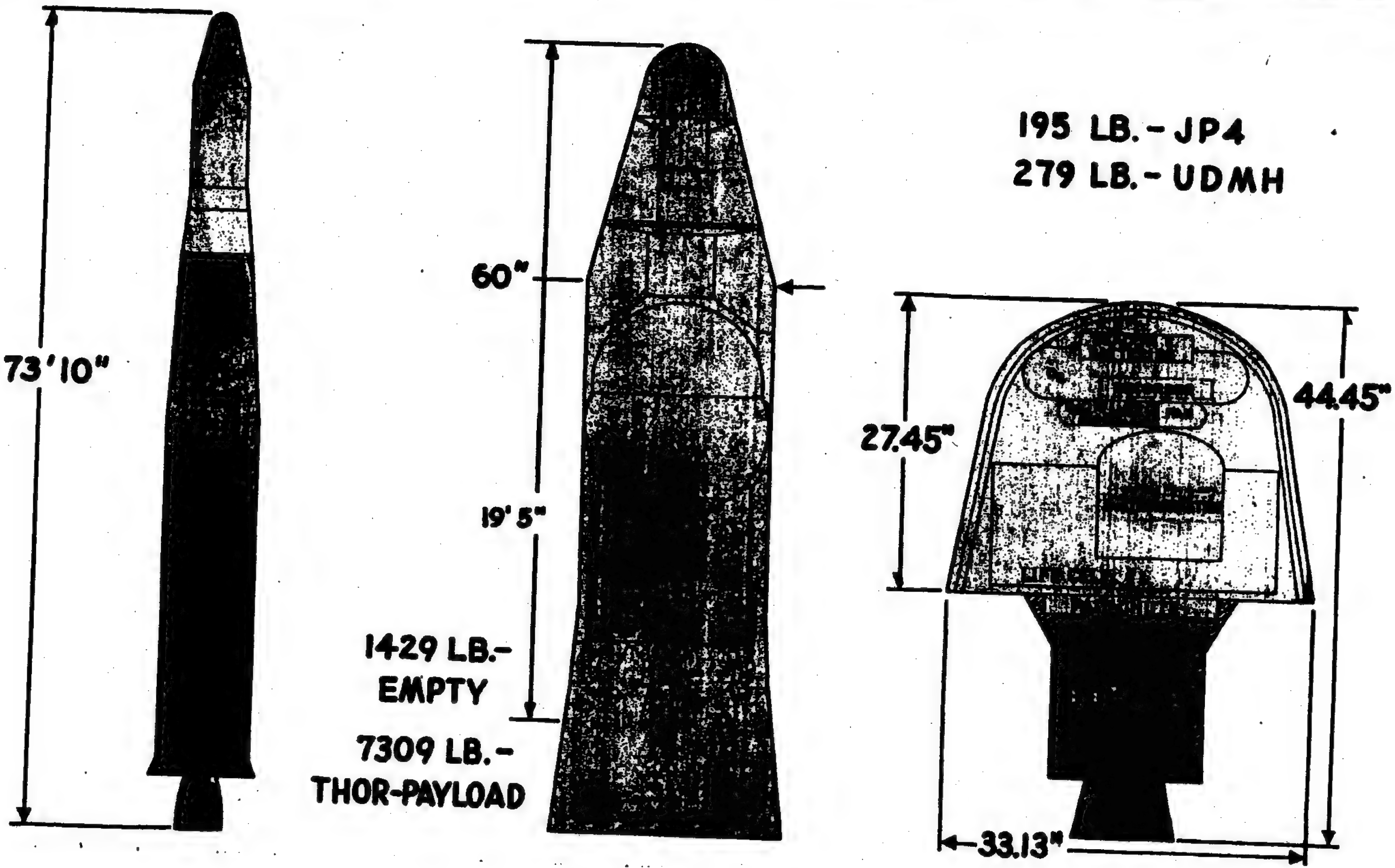
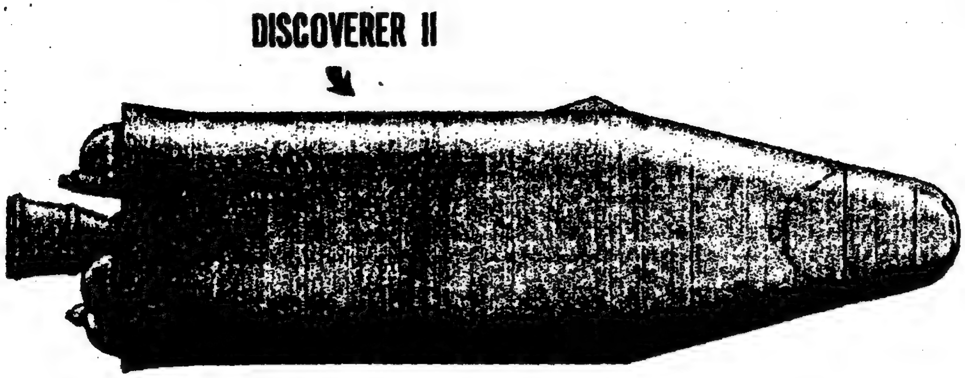
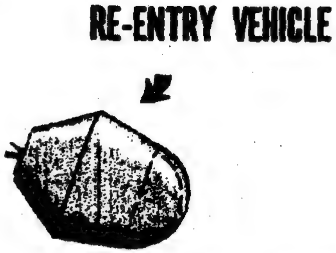


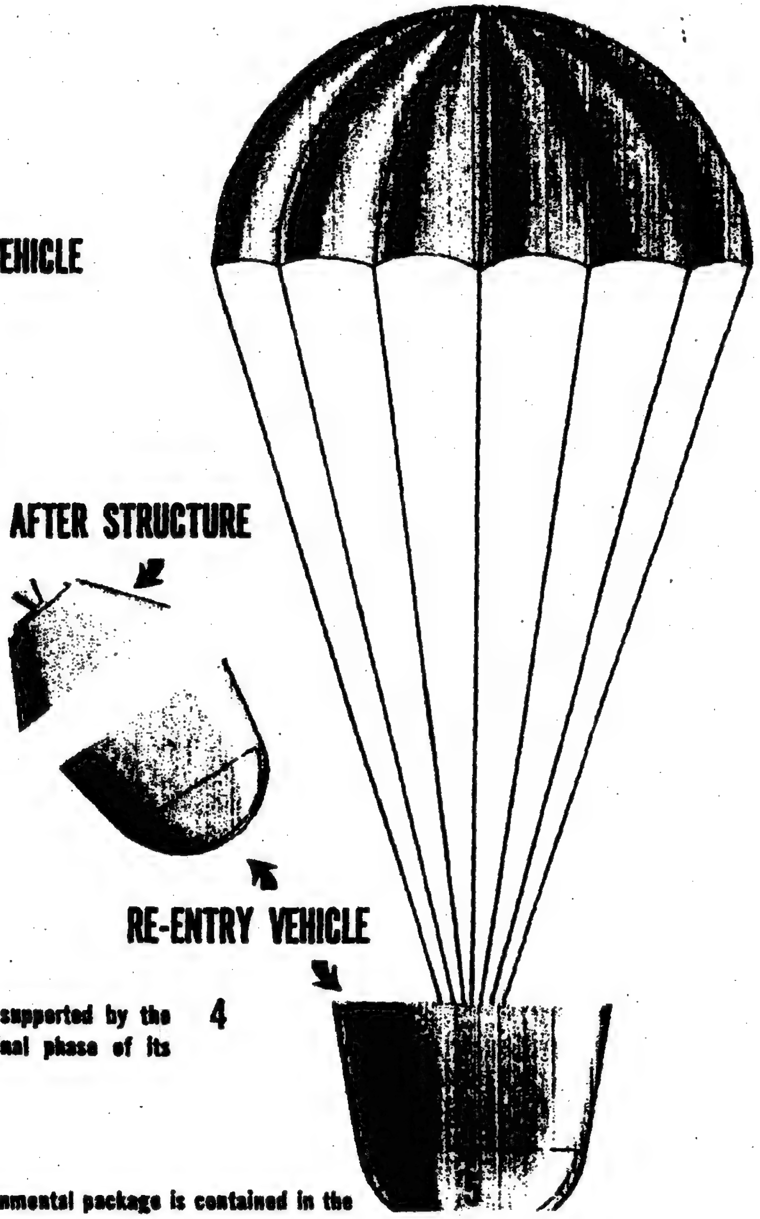
Figure No. 1



Discoverer II in orbit. The re-entry vehicle is outlined by the dotted lines. 1



Re-entry vehicle after separation from Discoverer II. 2



The after structure which contains the expended retrorocket separates just prior to re-entering the earth's atmosphere. 3

The re-entry vehicle is supported by the parachute during the final phase of its descent. 4

Figure No. 2

Environmental package is contained in the total of three attempts "with the 2 additional attempts if necessary and desired to be in lieu of payloads in the series of 13 flight vehicles. You should therefore plan to have available internal components for 2 primate backup payloads."[25]

Under joint AFBMD/contractor effort an attempt to launch the first Discoverer on 21 January 1959 failed. The Discoverer vehicle was damaged beyond repair but damage to the Thor Booster No. 160 was repaired and later used for the twelfth launch on 12 June 1960. The launch attempt was not thereafter counted as one of the Discoverer launches. The vehicle contained a simulated capsule. The bioastronautics research centered about the development and flight testing of two types of General Electric spaceborne biomedical systems.

Appendix C, Biomedical Space Specimens Fact Sheet, contains a history of the laboratory mice colony, four of which were destined for a space flight in the MARK I Biomedical Recovery Capsule.

The other biomedical system was the MARK II capsule under development by General Electric. It was a life support capsule designed to

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[26] Msg, DEF 951903 5 Dec 58.

carry a four to six pound Rhesus monkey into orbit. Appendix D Notes and Editorial Background for Primate Launch, contains a history of the bioastronautic animals AFBMD considered for orbit in the MARK II space capsule.

AFBMD launched the first Discoverer on 28 February 1959 but the satellite containing a simulated capsule did not obtain orbit.

AFBMD launched Discoverer II on 13 April 1959. The satellite carried a biomedical research capsule containing four mechanical mice made of a sensor or set of signals that appeared and behaved as an animal when picked up on telemetry, i.e. the animals had a pulse similar to the heartbeat rate as live mice.[26] The satellite achieved orbit but the was no recovery.

AFBMD launched Discoverer III on 3 June 1959. The satellite carried a biomedical research capsule containing four live mice. The satellite vehicle did not obtain orbit.[27]

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[26] x Military Satellite Program for Qtr ending 30 Jun 59

[27] : Ibid.

The Lockheed Missiles and Space Division designated the General Electric Company as the subcontractor for the life support system on 6 May 1958. Of thirteen tests beginning on 1 April 1959, only one was considered to have met its objectives. As the testing program progressed, it became increasingly evident that the development was beset by serious technical difficulties, although the primary technical competence in the bioastronautics area was actually within the Air Force. The General Electric cost had gone over the $2.0M level by Fall of 1959. In September 1959, Colonel Frederic C. E. Oder made the technical competence of the Air University School of Aviation Medicine, Randolph Air Force Base, Texas, available to General Electric Company, through the Bioastronautics Division, AFBMD, Headquarters, ARDC. In support of Subsystem L, representatives of Heqdquarters Air Research and Development Command, Headquarters United States Air Force, Air University (Headquarters School of Aviation Medicine), Air Force Missile Development Center, and Wright Air Development Center, reached agreements that all USAF biomedical resources concerning technical responsibilities be assigned to the School of Aviation Medicine. In September 1958, Colonel Frederic C. E. Oder made the technical responsibilities assigned to the Aviation School of Aviation available to the contractor through the Bioastronautics Division at AFBMD.[28]

Because of the basic design of the biomedical recovery capsule was faulty and as configured would not support the biomedical mission of the Discoverer series, the Commander, AFBMD, appointed an investigating board on an ad hoc basis "for the purpose of reviewing the management and technical status of the biomedical project currently associated with the DISCOVERER Program."[29] The board convened on 2 December 1959 and met daily through 8 December 1959. The Board published its report on 22 December 1959. The report contains background information pertaining to ARDC's designation and orgainization of the Office of Special Assistant for Bio-Astronautics to the Deputy Commander, ARDC, and appointment of Brigadier General Don D. Flinckinger as Special

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[28] Bioastronautics-Discoverer Board Report, 22 Dec 59

[29] SO No. 20, AFBMD (ARDC), 27 Nov 59.

Assistant to the Commander, AFBMD, for bioastronautics and as such to be "responsible for the direction and coordination of all the biomedical aspects of Projects assigned to" AFBMD.[30] The implications of General Flickinger's assignment as stated is discussed in the board report along with a discussion of early biomedical aspects of Discoverer that need not be repeated in this historical report inasmuch as the Bioastronautics-Discoverer Board Report may be found in Appendix A

## MAN-IN-SPACE ASPECTS

Start on separate page

~~Simultaneously with the development of a Life Support Capsule~~ for the Discoverer Program, the Air Force and Department of Defense initiated a Man-in-Space program.

On 26 and 27 February, 1958 General Curtis E. LeMay, Vice Chief of Staff, USAF, issued a directive to Lieutenant General Donald L. Putt, Deputy Chief of Staff, Development, USAF, to investigate feasibility of putting a man in orbit. On 28 February, ARDC representatives attended a meeting held at office of Deputy Chief of Staff, Development, Headquarters, USAF. Brigadier General Homer A. Boushey, Deputy Director, Research and

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[30] SO No. 18 ARDC 22 May 58.

Development, Headquarters, USAF, directed ARDC prepare and submit an abbreviated development plan for a Man-In-Space Program as soon as possible.[31]

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[31] USAF Manned Military Space Systems Development Plan, Vol I, 25 Apr 58, pp I-1-3,4.

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Wright Air Development Center made a Man-In-Space in-house study, and submitted its proposal to ARDC on 3 March 1958. WADC developed the study from review of contractor presentations and general approaches that were under study at NACA Laboratories, and ideas submitted by industry. ARDC developed the proposed abbreviated development plan from the WADC study. ARDC presented the proposed development plan to Headquarters, USAF, on 14 March 1958. NACA and Air Force Ballistic Missile Division representatives reviewed the plan prior to the presentation.*[32]

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[32]* *Ibid.*; OSD Memorandum, Mr. Roy Johnson, Director ARPA, 28 Feb 58.

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On 31 March 1958, the Commander, Air Research and Development Command directed that AFBMD prepare a development plan for a Manned

Military Space Systems Program with the goal of Manned Flight to the Moon and Return.x[33] AFBMD prepared the development plan in two volumes. Volume I contained two sections. Section I was a plan for Man-In-Space-Soonest and Section II was a plan for Man-In-Space-Sophisticated. Volume II contained Sections III and IV, Lunar Reconnaissance and Manned Lunar Landing and Return, respectively. The plan was not accepted but AFBMD prepared a new plan in two volumes on 2 May 1958, titled Man-In-Space-Soonest. The principal objectives were to put a man into "recognized space at the earliest possible date and to recover him safely on earth while determing functional capabilities and limitations of man operating in the space environment, especially the environment of weightlessness for protracted periods."[34] To accomplish preliminary objectives the development plan also provided that biomedical program activities authorized by the ARPA Director for the WS 117L for launch and recovery of biomedical capsules containing small primates would directly support and early man-in-space capability.[35]

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[33] x USAF Manned Military Space System Development Plan, Vol I, 25 Apr 58, p4.

[34] USAF Manned Military Space System Development Plan, 2 May 58, Man-In Space-Soonest, Vol I, p2.

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[35] Ibid. p I-1-10

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AFBMD submitted development plans dated 19 May, 28 May, 15 June and 24 July 1958, all of which were disapproved. But on 29 July 1958, after AFBMD had submitted the 24 July development plan, the 85th Congress approved the National Aeronautics and Space Act of 1958, which established a civilian agency to exercise control over aeronautical and space activities sponsored by the United States,

> "except that activities peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense."

The term "aeronautical and space activities" meant "aircraft, missiles, satellites, and other space vehicles, manned and unmanned, together with related equipment, devices, components and parts."[36]

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[36] National Aeronautics and Space Act of 1958.

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Another development factor was that the FY 1959 funds available for a man in space program was limited to $40.0M which caused "soonest" to be removed from the man in space program.

Mr. Johnson, ARPA, "suggested that the Air Force meet with representatives of NASA so as to arrive at a common understanding concerning the nature of the Air Force man in space development program which would be acceptable to NASA."[37] The meeting was held at Headquarters Air Research and Development Command on 12 August 1958. Shortly thereafter, Headquarters ARDC, directed AFBMD prepare a development plan incorporating "the essential characteristics discussed at the meeting and in which the Fiscal Year 1959 funding requirements were within the $40.0M limit."[38] AFBMD submitted the Man in Space Development Plan, dated 11 September 1958, to Commander, Air Research and Development Command, on 15 September 1958. The plan was the final Air Force plan. On 21 October, Robert R. Gilruth, Project Manager, NASA announced NASA, with the assistance of ARPA, of Department of Defense, was initiating a manned satellite project. On 25 November 1958, NASA issued NASA Order No. HS-24, requesting AFBMD construct and launch one Atlas C[*] Ballistic Missile booster with its associated control and guidance equipment. The booster was "required for launching a preliminary research of a nature that required a ballistic trajectory. The order was followed by HS-36 requiring AFBMD to construct and launch nine Atlas D boosters with associated guidance. The request was in addition to the request for one Atlas C booster covered by NASA Order HS-24, and a part of a "continuing program of research on manned satellites." NASA combined the two orders on 14 May 1959 by Amendment Number 1 to NASA Order HS-36. AFBMD submitted a Space System Development Plan, Preliminary Research for Man-in-Space on 2 February 1959, based on NASA Order HS-24. By 4 February 1959, the Man-in-Space Program became known as Project Mercury. Hugh L. Dryden, Deputy Administrator of NASA and Robert R. Gilruth, Director of Project Mercury gave the manned space system its name.[*][39] Mr. Glennan chose Wright Brothers' Day, 17 December 1958, to announce publicly in Washington, D. C., that the manned satellite program would be called Project Mercury.

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[37] Man In Space Development Plan, 11 Sep 58.

[38] Man in Space Development Plan, 11 Sep 58, p I-1

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[39][*] This New Ocean, NASA, 1966, p 132.

[*] The Atlas C was to be used to check the aerodynamics of the spacecraft scheduled about May 1959. It was to be the launch vehicle for the Big Joe reentry test shot, but plans were changed and an Atlas D vehicle was used. (Project Mercury, a Chronology, NASA 1963)

## BIOASTONAUTICS ORGANIZATION

In the meantime the Vice Commander, Brigadier General O. J. Ritland, Vice Commander, AFBMD, announced the Organization of the Deputy Commander Military Space Systems, AFBMD, effective 12 September 1958, by separating the space effort from the Office of Deputy Commander, Technical Operations. Ritland announced the establishment of the Directorate Air Force Bio-Astronautics but did not at the time name the director.[40] Lieutenant Colonel Edward L. Cole became Director of Directorate Air Force Bioastronautics in October 1958 and remained in that position until his retirement on 30 November 1963. Cole was promoted to the rank of colonel in the Spring of 1961.[41] The Directorate Air Force Bioastronautics was renamed Directorate Bioastronautics Projects in Mid-1959 and then ~~became Bioastronautics~~ again renamed in 1960 when the organization became Bioastronautics Office. The next change occurred after the general reorganization of Air Research and Development Command and Air Materiel Command effective 1 April 1961 when Air Force Ballistic Missile Division became Space Systems Division. The Bioastronautics Office became Bioastronautics/Re-Entry Office. The office became a Directorate again in August 1961 and on 15 December 1961, the Directorate became the Manned Military Space Capability Vehicle (MMSCV) Directorate. The Director was responsible for planning and managing the Manned Military Space Capability Vehicle and other space programs in the Bioastronautics area for the Space Systems Division, and program manager for the 698AA Program,[42] formerly known as Bioastronautics Orbital Space System (BOSS).

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[40] Memorandum for Generals ~~Funk, Lange, Dr. Ramo and All Personnel~~, ~~AFBMD, 16 Sep 58,~~ subj: Organizational Announcement, Organization of the Deputy Commander Military Space Systems, AFBMD, 16 Sep 58.

[41] Historical Report, MMSCV Directorate, 1 Jul - 31 Dec 63.

The final title of the bioastronautics office was Manned Environmental Systems Directorate acquired on November 1963. Colonel Charles W. Craven became Director on 30 November 1963. In January 1964, the Air Force Aerospace Medical Division, AFSC, began establishing its Los Angeles Office, Aerospace Medical Division, for support of the Manned

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[42] Historical Report, MMSCV Directorate, 1 Jul - 31 Dec 63; Organization and Functions Chart Book, SSD, Jan 62.

Orbiting Laboratory Program that had been assigned to Space Systems Division.[43] Colonel Charles W. Craven, was relieved from his duty as Director Manned Environmental Systems and assigned primary duty as Assistant Deputy Director Program 437., Deputy for Systems Management, effective 16 April 1964.[44]

On 31 August 1965, the Secretary of the Air Force, Eugene M. Zuckert, announced the appointment of General Bernard A. Schriever as Director of the Manned Orbiting Laboratory Program, an assignment in addition to his duties as Commander of AFSC. Zuckert directed that Schriever, as Director of MOL, report directly to Secretary of the Air Force.[45]

At the same time, Zuckert named Brigadier General Henry L. Evans, who had been serving as Special Assistant to the Secretary of Air Force for MOL, Vice Director of the MOL Program, and Brigadier General Russell A. Berg Deputy Director of the MOL Systems office.[16] There was no change in the location of the MOL office.

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[43] xDaily Bulletin No. 134, SSD, 10 Jul 64; History Aerospace Medical Division, Administration, 1 Jan - 30 Jun 64, p2.

[44] SO PB-22, SSD, 22 Apr 64, para 1.

[45] News Release No. 65-149, 31 Aug 67.

Program 698AA had its beginning when AFBMD awarded a study contract with Lockheed Missiles and Space Division to determine feasibility of supporting a 60 pound primate for 48 hours on orbit. Lockheed completed the Advanced Biomedical Capsule Study, including preliminary drawings and a full-scale mockup, on 17 June 1960. The study indicated the feasibility of maintaining a chimpanzee in orbit for two days. The capsule was to be integrated with the SAMOS recovery vehicle.[17] The Directorate of Bioastronautics Projects accepted the full-scale mockup of the advanced biomedical capsule on 15 August 1960, and became Phase II of the Bioastronautics Orbital Space System.[18] Preliminary work for preparation of the BOSS Development Plan started in December 1960. In

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[16] Ibid.

[17] Summary of AFBMD Division Activities in Space, Jun 60, p A-9; AFBMD Chronology, Office of Bioastronautics (WDZB), 1 Jul-31 Dec 60

[18] AFBMD Chronology, Office of Bioastronautics (WDZB) 1 Jul - 31 Dec 60.

April 1961 the plan was forwarded to Air Force Systems Command (AFSC)* for approval. The program called for six orbital flights into the radiation belts to determine the effects of prolonged exposure to weightlessness and space radiation. Champanzees were to be utilized as the test subjects.[49] Phase I of a five year bioastronautic program development plan entitled "Biomedical Program," that described a four launch, small primate series within the Discoverer Program had been submitted by General Bernard A. Schriever, Commander, Air Research and Development Command,* in November 1960. It had become apparent that the animal series scheduled in the Discoverer Program for 1959 and 1960 was to be canceled.[50]

As of 16 May 1961, the Deputy Chief of Staff, Development, USAF, had not approved Phase I plan and on that date General Schriever resubmitted the November plan together with the Phase II plan for an advanced technology program "Bioastronautics Orbital Space System (BOSS) describing a series of six chimpanzee launches. The BOSS plan was for Phase II of a five year Bioastronautic Program "providing for a series of live animal orbital and space probe launches."[51]

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[49] Office of Bioastronautics (SSZB) Progress Report 1 Jul 60 - 1 Jul 60

[50] Ltr, SSD (SSZ)* to AFSC (MSF), subj: Air Force Support of Bioastronautics Program 698AA, 2 Aug 63; Ltr AFSC (SCRBS) Schriever to Hq USAF (AFDDC), subj: Bioastronautics Development Plan, 16 May 61.

* Through general reorganization of the Air Force, Air Research and Development Command had become Air Force Systems Command on 1 Apr 1961. Air Force Ballistic Missile Division had become Space Systems Division, AFSC.

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[51] Ltr, AFSC (SCRBS), Schriever, to Hq USAF (AFDDC, subj: Bioastronautics Development Plan, 16 May 61.

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In October 1960 with approval of General Thomas D. White, Chief of Staff, USAF, Lieutenant General Schriever, appointed the Air Force Space Study Committee* with Trevor Gardner, former Special Assistant to Secretary of the Air Force for Development, Chairman, to assist Air Research and Development Command in formulating a space Development program which would best serve the national interest. The Committee recommended in its report dated 20 March 1961, "the immediate accomplishment of a biological space flight research program."[52]

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[52] Ibid.; Ltr USAF, General Thomas D. White to Lt Gen Bernard A. Schriever, 10 Oct 60; Msg, ARDC, RDGP-12-10-2-E, 12 Oct 60

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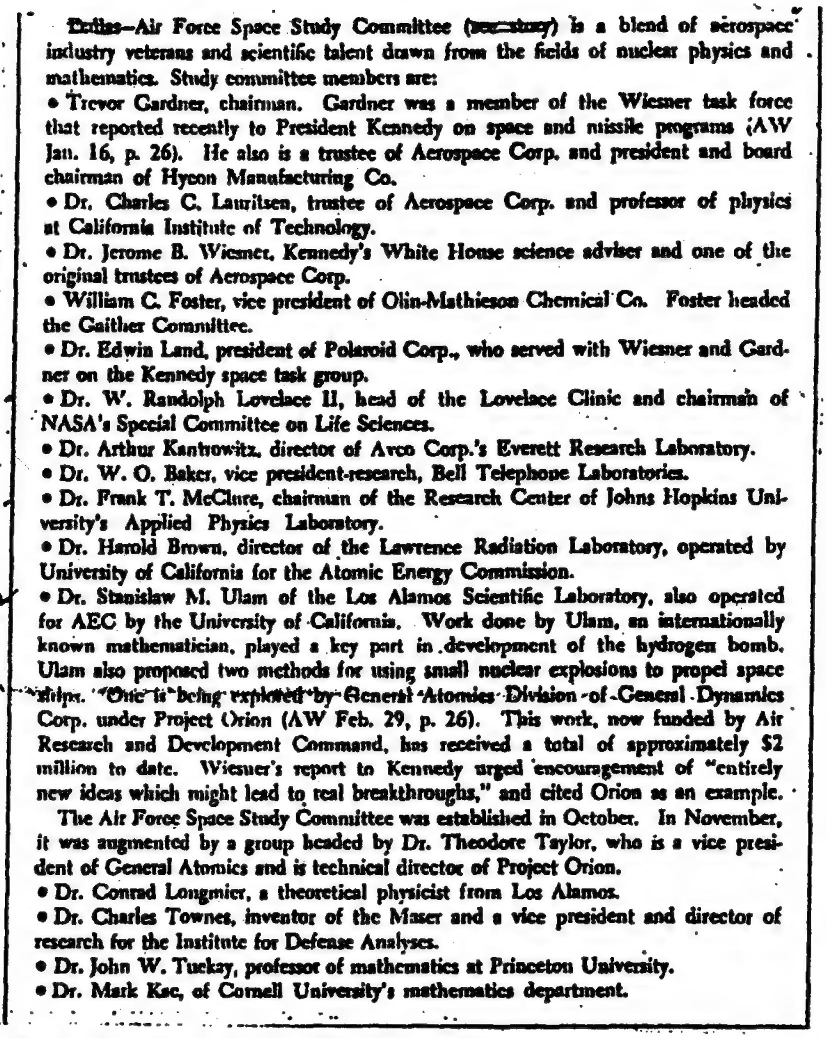
* See next page for footnote



~~Dallas~~—Air Force Space Study Committee (~~see story~~) is a blend of aerospace industry veterans and scientific talent drawn from the fields of nuclear physics and mathematics. Study committee members are:

- Trevor Gardner, chairman. Gardner was a member of the Wiesner task force that reported recently to President Kennedy on space and missile programs (AW Jan. 16, p. 26). He also is a trustee of Aerospace Corp. and president and board chairman of Hycon Manufacturing Co.
- Dr. Charles C. Lauritsen, trustee of Aerospace Corp. and professor of physics at California Institute of Technology.
- Dr. Jerome B. Wiesner, Kennedy's White House science adviser and one of the original trustees of Aerospace Corp.
- William C. Foster, vice president of Olin-Mathieson Chemical Co. Foster headed the Gaither Committee.
- Dr. Edwin Land, president of Polaroid Corp., who served with Wiesner and Gardner on the Kennedy space task group.
- Dr. W. Randolph Lovelace II, head of the Lovelace Clinic and chairman of NASA's Special Committee on Life Sciences.
- Dr. Arthur Kantrowitz, director of Avco Corp.'s Everett Research Laboratory.
- Dr. W. O. Baker, vice president-research, Bell Telephone Laboratories.
- Dr. Frank T. McClure, chairman of the Research Center of Johns Hopkins University's Applied Physics Laboratory.
- Dr. Harold Brown, director of the Lawrence Radiation Laboratory, operated by University of California for the Atomic Energy Commission.
- Dr. Stanislaw M. Ulam of the Los Alamos Scientific Laboratory, also operated for AEC by the University of California. Work done by Ulam, an internationally known mathematician, played a key part in development of the hydrogen bomb. Ulam also proposed two methods for using small nuclear explosions to propel space ships. One is being exploited by General Atomics Division of General Dynamics Corp. under Project Orion (AW Feb. 29, p. 26). This work, now funded by Air Research and Development Command, has received a total of approximately $2 million to date. Wiesner's report to Kennedy urged encouragement of "entirely new ideas which might lead to real breakthroughs," and cited Orion as an example.

The Air Force Space Study Committee was established in October. In November, it was augmented by a group headed by Dr. Theodore Taylor, who is a vice president of General Atomics and is technical director of Project Orion.

- Dr. Conrad Longmier, a theoretical physicist from Los Alamos.
- Dr. Charles Townes, inventor of the Maser and a vice president and director of research for the Institute for Defense Analyses.
- Dr. John W. Tuckay, professor of mathematics at Princeton University.
- Dr. Mark Kac, of Cornell University's mathematics department.

From Aviation Week, 23 Jan 1961

Immediately after the "Gardner Committee" submitted its report, the Secretary of the Air Force and the Chief of Staff, USAF, directed the Commander, AFSC (reorganization of ARDC occurred on 1 April 1961 and ARDC became AFSC) that a Five Year Air Force Space Plan based on a detailed study of the "Gardner Committee" Report be prepared for submission to the Secretary of Defense by 28 April 1961. Secretary of Department of Defense McNamara specifically desired recommendations for changes in the space program current at that time. General Schriever directed Lieutenant General Howell M. Estes, Jr., Deputy Commander, Air Force Systems Command for Aerospace Systems, and Major General Osmund (Ozzie) J. Ritland, Commander, Space Systems Command (newly formed from AFBMD and portions of Ballistic Missiles Center, Strategic Air Command on 1 April 1961) establish a Task Group under the chairmanship of Major General Joseph R. Holzapple, Assistant Deputy Commander for Aerospace Systems (newly formed to manage the Space Systems Division and the Ballistic Systems Division) and co-chaired by Colonel Harry S. Evans, Deputy Commander Space Systems Division for Satellite Systems.

The Task Group completed its report, known as the "Holzapple Report" and Air Force Secretary Eugene M. Zuckert submitted the USAF Proposed National Space Program to the Secretary of Defense on 1 May 1961.[53]

Major General O. J. Ritland, Commander, Space Systems Division, submitted the expanded Bioastronautics Orbital Space System (BOSS) Development Plan to Lieutenant General B. A. Schriever, Commander, Air Force Systems Command, on 31 May 1961. The plan was one of eight development plans submitted on 31 May 1961 in honor of a request from Schriever for detailed documentation in support of the five-year space plan "recently submitted to the Secretary of Defense."[54] The plan included recommendations for the establishment of a Manned Lunar Expedition as the national space goal, beginning with the orbit of small primates up to four days duration late 1961.

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[53] OSD Memorandum for the Secretary of Defense, subj: USAF Proposed National Space Program, 1 May 61

[54] Msg, SCG 10-5-27, 102210Z May 61; Ltr, SSP, subj: Development Plans in support of Five-Year Space Plan, 31 May 61.

The Deputy Chief of Staff, Development, USAF, notified AFSC on 12 June 1961 that the "essential objectives of Phase I of the proposed five year bioastronautic program will be achieved through the joint Air Force-NASA effort covered in the 8 June 1961 letter from this Headquarters to AFSC and ATC, subject: Radiation Shielding." Phase II of the program was approved but the title was changed to Bioastronautics Orbital Space Program (BOSP).*[55] The Bioastronautics Orbital Space Program was updated in January 1962 and title was changed to Space Program 698AA.*[56]

On 18 February 1962, the Director of Development Planning, Deputy Chief of Staff, Research and Technology, USAF, issued Advanced Development Objective No. 35 for a Bioastronautical Space Test Program. Action required was that the Air Force Systems Command update as necessary the Space Program 698AA (Jan 1962) Development Plan and keep National Aeronautics and Space Administration fully "appraised of the test program objectives to assure correlation of NASA interests and elimination of unwarranted duplication.x[57]

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[55] * Ltr, USAF (AFDDC) to AFSC, subj: Bioastronautics Orbital Space Program (BOSP), 12 Jun 61; Ltr, AFSC (SCRBS) to SSD, ATC, subj: Bioastronautics Orbital Space Program (BOSP), 22 Jun 61.

[56] * Development Plan, Space Program 698AA Updated, Jan 62.

Secretary of Defense Robert McNamara and Director of NASA, Mr. James T. Webb, decided the fate of Program 698AA on 19 July 1962 and that was:

1. The DoD will not fund this program or any portion of it.

2. If it or some modification of it is to be supported, NASA will fund for it and assume program responsibility

3. The NASA will utilize DoD resources especially bioastronautics science resources to the maximum and will not duplicate these in undertaking the program, and,

4. The DoD will, in the event that NASA decides to go forward with the program, charge NASA only the incremental costs of DoD's effort not prorated overhead costs.

NASA assumed responsibility for a modified and renamed version of Program 698AA. Aerospace Medical Division furnished funds limited to the supporting Applied Research Tasks documented under Project 6770 during FY 1963 and the first part of FY 1964. Late in 1963, Aerospace Medical Division did not concur in the continued use of funds from Project 6770 for support of Program 698AA and recommended reorientation of effort to other exploratory developments.*58

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[57] x ADO No. 35, 18 Feb 62.

Project 6770 was the Air Force Systems Command identification for Department of Defense Program Element 62405154, Bioastronautics. The lead division responsible for management and organization was Research and Technology Division, AFSC, and the Project Office was Aerospace Medical Division (AFSC), Brooks Air Force Base, Texas. The following is a description of the Program Element.*59

> (S gp3) **SCOPE AND CONTENT:** This program element includes the investigation of biological effects of the atmosphere and methods for protecting the human operator against environmental and flight vehicle stresses. It also includes the development of techniques and equipment to sustain life or counteract the thermal, barometric, biomechanical, and radiation extremes which are otherwise incompatible with life.
>
> **PURPOSE:** Work in this program element includes projects devoted to investigation of the biological effects of radiation, prolonged acceleration, weightlessness, and confinement; development and proof testing of techniques and equipment to sustain man in closed cells and suits for a series of time periods; development of methods for protecting the human operator. Life support efforts include development of components to function in a weightless state, regenerative gaseous systems, and waste re-cycling techniques. In the area of weightlessness, studies are also conducted to determine functional and chemical effects of long-term, zero-g exposure. This effort has been re-oriented to specifically support approved or planned advanced performance flight programs such as F-111, Advanced Manned Strategic Aircraft (AMSA), and Manned Orbiting Laboratory (MOL).

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58* Ltr SSD (SSZ), Funk to AFSC (MSF), ~~26 Nov 63~~ subj: Air Force Support of Bioastronautics Program 698AA, 26 Nov 63.

59* DAF, USAF Force & Financial Program, Sec I: Program Element Summary Data, VI: Research and Development, 8 Jan 65, p 6-18; AFSC (USAF) R & D Projects, Priorities & Program Elements, 31 Dec 64.

RELATED ACTIVITIES: This effort is applicable to all near-space and advanced aero-dynamic flight programs. Currently, the NASA and the Air Force are participating in bioastronautics planning for an orbital space station; and, the Air Force is working with the NASA in the identification of problems which are unique for the Manned Orbiting Laboratory (MOL).

MAJOR ACCOMPLISHMENT: Acceleration studies have been performed in which flight profiles and stresses of emergency procedures have been carefully simulated. A life support system of flyable hardware has been developed, based on super-critical gas storage and supply. A series of capsule (confinement) studies has been accomplished and a space cabin simulator has been accomplished and a space cabin simulator has been operated using a 2-gas (oxygen and nitrogen) life support system.

The Director of Defense Research and Engineering, Department of Defense approved the Manned Military Orbiting Laboratory Program in December 1963, and assigned the program to the Air Force.~~x~~[60]

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[60] ~~x~~ DDR&E Memorandum for Assistant Secretary of the Air Force (R&D), ~~11 Dec 63~~ subj: Manned Orbital Program, 11 Dec 63.

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The Commander, AFSC, notified SSD on 16 December 1963 that the "lead division for management of this entire manned space effort, including ASSET, is SSD. The full support of the other divisions and centers is essential."~~x~~[61] ASSET was the short title for Aerothermodynamic/elastic Structural Systems Environmental Tests.

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[61] ~~x~~ Ltr, AFSC, Schriever to SSD, 16 Dec 63, subj: Manned Space Program.

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The MOL system consisted of major elements already in a variety of stages of development. The management of the medical and biological aspects of MOL was delegated to the Aerospace Medical Division, Brooks Air Force Base, Texas. The Commander, Aerospace Medical Division (AMD) ordered Colonel Andres I. Karstens, Commander of the Division's Aerospace Medical Research Laboratories at Aerospace Systems Division, Dayton, Ohio, to Space Systems Division on temporary duty to establish an operating location for the AMD. SSD maintained the already established bioastronautics office, the Manned Environmental Systems Directorate until the end of June 1964. An extensive revision of the budget during the last half of Fiscal Year 1964, enabled AMD to fund the Los Angeles Office beginning July 1964. The office was known as the Bioastronautics and Aerospace Medicine Operating Location Office (BAMOLO) until the end of June 1964. On 20 July, Colonel Karsten's title became Assistant for Bioastronautics and Aerospace Medicine and the Los Angeles Office, Aerospace Medical Division. Major Edward F. Westlake, Jr., who had reported on 15 February 1960 and been assigned Chief, Bioengineering Division of the Manned Environmental Systems Directorate was transferred to the AMD office as Project Officer, Bioastronautics (AMD) Special

Projects Division for MOL, Deputy Commander for Manned Systems, effective 1 April 1964.*[62]

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[62] * SO PB-17, SSD, 1 Apr 64, para 6; AFBMD Chronology, Directorate of Bioastronautics (WDZJB) 1 Jan - 30 Jun 60.

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The assignment of the Manned Orbiting Laboratory System to Space Systems Division was the end result of years of planning in the Department of Defense, Department of the Air Force, Air Force Systems Command and Space Systems Division and/or their predecessor offices. The assignment of MOL to Space Systems Division had come about by Agreement between the Department of Defense and the National Aeronautics and Space Administration covering a possible new Manned Earth Orbital Research and Development Project signed on 17 August 1963 by Robert S. McNamara, Secretary of Defense and James E. Webb, Administrator, National Aeronautics and Space Administration.

The Man-in-Space route through the WS 117L never did materialize for except the four live mice* that were launched in the MARK I life support capsule aboard Discoverer III on 3 June 1961, no other animals were launched in the Discoverer Program.[x 63]

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* Three black mice, Sally, Amy and Moe, were launched "piggy-back" on a re-entry test of an RVX-2A nose cone atop an Atlas ICBM (Atlas 71D) fired from Cape Canaveral on 13 October 1960. The three mice, an experiment sponsored by the Air Force School of Aviation Medicine and the Bio-Astronautics Directorate of AFBMD rocketed 650 miles into space and survived an 18,000 mph plunge to a planned impact area 5,000 miles down range. (Astro-News, Hq AFBMD (ARDC), Wed 26 Oct 60; History of the Command 6555 Test Wing (Development) Patrick AFB, Fla, 1 Jul - 31 Dec 60).

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[63 x] Prototype Biomedical Capsule - Exhaustion Test Final Report, prepared by Lockheed Missiles and Space Company, Jun 63.

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The development, fabrication, and preflight testing of the Subsystem L, MARK II Biomedical Recovery Capsule was completed and the first unit was accepted as a flight qualified item for launch on a Discoverer satellite vehicle by November 1960.[x 64] The Office of Security Review,

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[64 x] Historical Report, Bioastronautics Office (WDZB) 1 Jul - 31 Dec 60.

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Department of Defense, approved a news release on 10 January 1961 for a Discoverer Vehicle carrying a five week old American born monkey.[x]

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[x] Ltr, SAFOI-3B, to AFBMD, subj: Biomedical Release, 12 Jan 61

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On 31 January 1961, NASA launched Ham, a 37 pound chimpanzee, a trainee of U. S. Air Force Medical Laboratory, Wright Air Development Division, Dayton, Ohio, by an Army Redstone rocket (MR-2). Ham survived the suborbital, 420 statute mile, down range flight from Atlantic Missile

Range and was recovered. The spacecraft reached an altitude of 155 statute miles.~~*~~65

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65~~*~~ Space Medicine in Project Mercury, NASA, by Mae Mills Link, p 115.

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On 29 November 1961, NASA launched Enos, a 42 pound chimpanzee in a Mercury Capsule, boosted by an Atlas (MA-5). Enos, a graduate of University of Kentucky, Lexington, Kentucky, and Air Force Aeromedical Field Laboratory, Holloman Air Force Base, New Mexico, survived a three orbital flight and was recovered.~~*~~66

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66~~*~~ Animal Astronautics by Clyde R. Bergwin & William T. Coleman, Prentice-Hall, Inc., pp 151-154.

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Prior to 31 January 1961, NASA had launched small primates. On 3 December 1958, a South American squirrel monkey was launched from AMR in the nose cone of an Army Jupiter missile and was carried 300 miles into space. The monkey, Gordo, "the first monkey known to have traveled through space" survived the flight but "was lost when a mishap occurred to the vehicle on reentry." Officers of the U. S. Army and Navy Medical Corps conducted the biological experiment.~~*~~67

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67~~*~~ *Ibid.*, pp 135-138

The next NASA primate flight, launched on 28 May 1959 from AMR by an Army Jupiter booster, sent two female monkeys, Able, a seven pound American born rhesus monkey, and Baker, a one pound squirrel monkey, to an altitude of 300 miles. Both animals were recovered alive but Baker died a few days later while undergoing an "operation for removal of an electrode" that "had been implanted just under the skin in order to derive biomedical information during the course of the ... flight."*[68]

NASA next launched a rhesus monkey in the Mercury Army Little Joe (LJ-2) series on 4 December 1959, from Wallops Island, Virginia. The monkey named Sam in honor of the Air Force School of Aviation Medicine, an organization that had become a unit of the Aerospace Medical Center, Brooks Air Force Base, Texas, on 1 Actober 1959, traveled 55 miles into space and was recovered approximately two hours after launch.*[69]

The last monkey NASA launched was Miss Sam, a rhesus monkey, in another Mercury Little Joe series flight (LJ-1B). Miss Sam also a resident of the Air Force School of Aviation Medicine, survived a nine

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68 * Ibid., pp 138-140

69 * Ibid., p 143; History Aerospace Medical Division, Administration, 1 Jan - 30 Jun 64, p Viii.

~~CONFIDENTIAL~~

mile high, fifty-eight minute flight on 21 January 1960.[x70]

(C gp 3) The Space Systems Division also launched two primates--not as a part of Discoverer Program but instead for reentry tests. The Bioastronautics Office, initiated Project SPURT (small primate unrestrained) with General Electric Company, Philadelphia, Pennsylvania, in February 1961. Six healthy monkeys selected at Holloman Air Force Base, New Mexico, and trained in a "central psychomotor task requiring response to light signal activated every two-and-a-half minutes for 30 seconds denoting the availability of water. . . . The animals responded by drinking from the water feeder approximately 85% of the time encompassed by the flight." An Atlas 32E equipped with a life support capsule was launched from ETR with a squirrel monkey on board, on 10 November 1961. Thirty seconds after lift-off, the Atlas became erratic and had to be destroyed. Three days later the SPURT capsule was recovered from a point several hundred yards off-shore. The autopsy showed that the animal suffered multiple fractures of the skull believed to be the result of the impact rather than

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[70x] Ibid., p 145; MASA SP-45 Mercury Project Summary, including Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963.

~~CONFIDENTIAL~~

the explosion. No other vehicle was readily available for another attempt to fly a Project SPURT so the project was terminated.*[71]

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71 * Historical Report, MMSCV Directorate, 1 Apr - 31 Dec 61.

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(CGp3) On 19 December 1961, a recoverable Scientific Passenger Pod carrying a small primate was launched piggyback aboard Atlas 36E from the Atlantic Missile Range. A miniature one-channel transmitter had been implanted within the body of the primate which successfully sensed and telemetered to ground stations the primate's electrocardiogram during 37 minutes of flight (from lift off to re-entry) including approximately 30 minutes of weightlessness. The objectives of the experiment were met but the primate was not recovered. During flight, the primate was enclosed in a small cylindrical biomedical capsule, 28 inches in diameter and 30 inches in length, which was in turn placed in a bullet shaped seven-foot recoverable pod that was attached to the outside and near the rear end of the Atlas E booster.*[72] (See Figure 3)

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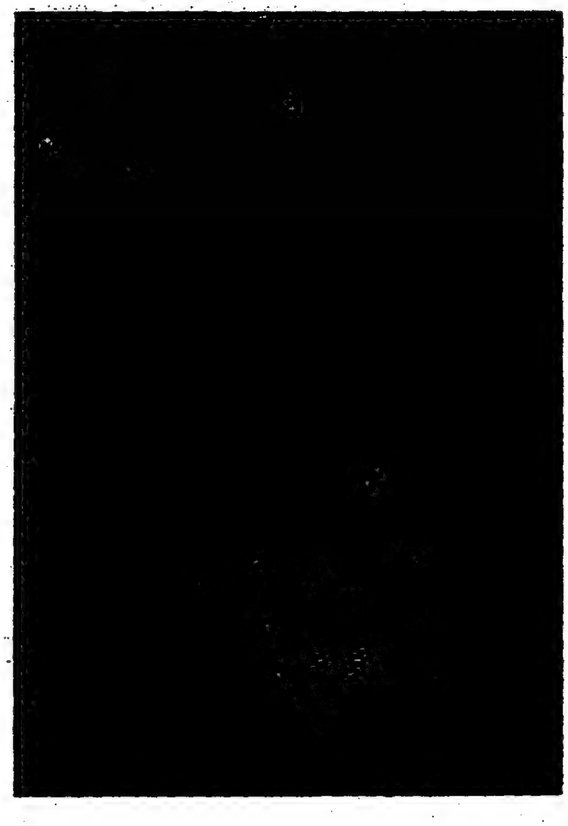
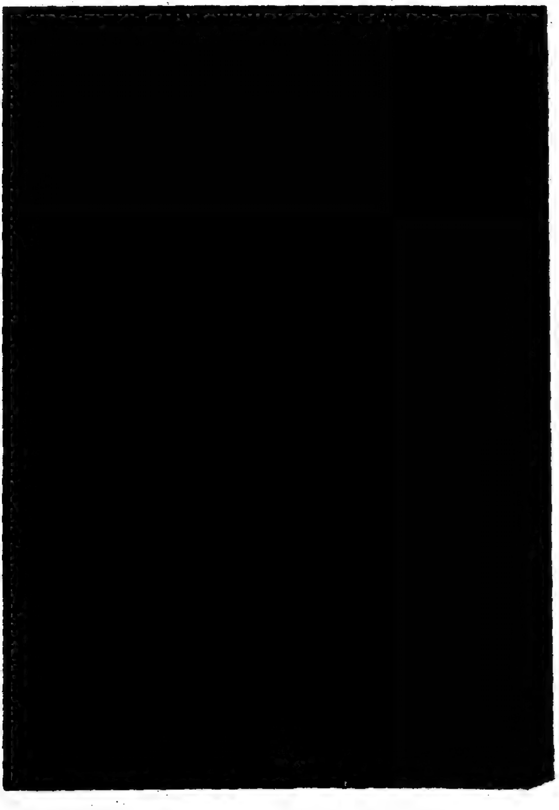
72 * *Ibid*.

A very successful study has been completed demonstrating the feasibility of "leadless" transmission of one channel of data from a surgically implanted transmitter through the intact skin of a monkey. This development gives a new and unique technique for measuring, transmitting and recording environmental physiological data from space vehicles. A follow-on study will lead to a surgically implanted multi-channel miniaturized bio-transmitter. Operational feasibility will be demonstrated by launching an animal with the device installed on at ATLAS "E" Pod during CY 1961. Photo above provides a comparison of the size of the miniature radio transmitter for use in the surgical implant technique. Leads shown pick up natural physiological electrical signals for transmission through the primate's intact skin. Left is the primate containing the transmitter, on the pallet with the restraint harness in place. The connectors visible on the pallet carry the signal from the receiving antenna in the pallet payload equipment for amplification and subsequent transmission to ground stations. At right is an X-ray picture showing the miniature transmitter implanted in a Rhesus monkey. Electrical leads pick up signal concerning physiological phenomena.





group 3

Figure 3

## DISCOVERER VEHICLE No. 1025

Sometime between 13 February and 6 April 1961 the Life Science Aspects of the Discoverer development Program was deleted. The Discoverer Vehicle No. 1025 equipped with the MARK II Biomedical Recovery Capsule, was put into storage and was never used in the Discoverer Program.[73] The Vehicle had arrived at Santa Cruz Test Base on 24 April 1959 and was scheduled for hot firing tests and for testing and checkout. By 23 July 1959, the vehicle along with Thor Booster No. 200 was in the Missile Assembly Building, Vandenberg Air Force Base, ready to be transferred to Pad 4 after launch of Discoverer V.[74]

General Electric Corporation was proceeding on a crash basis to improve the primate life support capsule. A test in May 1959 at Sunnyvale had resulted in the death of the primate subjected to the test.[75]

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[73] UPI News Release 28 August 1961

[74] Discoverer Monthly Program Progress Report, 8 May 59.

[75] Discoverer Monthly Program Progress Reports, 8 May 59, 8 Jun 59 and 7 Aug 59.

After Discoverer V was launched on 13 August 1959, the Discoverer Vehicle No. 1025 was rescheduled for launch with Thor Booster No. 206 as Discoverer VII.[76] In September 1959, Discoverer Vehicle No. 1025 was again rescheduled for launch with Thor Booster No. 234 as Discoverer XI, but again a designated Discoverer did not carry the MARK II capsule. Biomedical testing with a live primate was discontinued to resume late in January while awaiting modification of a capsule to correct an air conditioning deficiency,[77] but in January resumption of the biomedical capsule testing was rescheduled to begin on 8 February in the Lockheed Missile and Space Division's high altitude temperature simulation chamber. After successful completion of the test series and fabrication of the final flight capsule, Discoverer Vehicle No. 1025 was scheduled for launch as Discoverer XV.[78] The first full-duration test of the capsule containing a live primate was completed on 12 February. The 55-hour test, simulating a complete flight was initiated at Vandenberg AFB with the primate sealed in the capsule. A countdown was performed, and after 22 hours the capsule containing primate was flown to the Sunnyvale Development Center where it was placed in the High Altitude Temperature Simulator for a simulated orbital phase. It was then placed in temperature-regulated water for five hours to simulate the final five-hour recovery phase. During the tests the primate properly responded to stimuli and was able to perform all programmed tasks. ~~Appendix No. 4~~ Notes and editorial background for primate launch may be found in Appendix D. Appendix E is a series of photographs that show test animals and how they are tested. School of Aviation Medicine had designed a new feeder that worked properly. Electrocardiogram readouts were excellent and all components of the air regeneration system functioned properly.[x 79]

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[76] Summary of AFBMD Activities in Space, Aug 59.

[77] Summary of AFBMD Activities in Space, Oct-Nov 59, pp A-6 and A-9.

[78] Summary of AFBMD Activities in Space, Dev 59-Jan 60, p A-7

Intensive efforts were continued during March to obtain additional data on which reliability studies and capsule recovery probability analyses could be based. LMSD reliability engineers reviewed the problem with General Electric Company. In April, another test capsule was scheduled

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[79 x] Summary of AFBMD Activities in Space, Feb 60, p A-7

for delivery to LMSD in May at which time specialized biomedical environmental testing of flight componets would begin.[80] The May delivery of the test capsule for use in specialized environmental test of MARK II flight components was rescheduled for delivery to LMSD in August.[81] A completely successful orbital simulated test of the MARK II biomedical capsule with a live female Rhesus monkey passenger was conducted in October. The monkey was put into the life cell of the capsule on 21 October at Vandenberg AFB during a simulated launch countdown. The sealed capsule was then flown to Sunnyvale and placed in the high altitude simulator on 22 October. The monkey was removed from the simulator on 24 October. Throughout the 65-hour period the primate was dependent upon the life cell for its existance and was in an exceptionally vigorous condition when she was removed.[82] The MARK II flight scheduled for Discoverer XV was postponed as Discoverer XV was launched on 13 September 1960 without Vehicle No. 1025 and it's passenger. The flight was rescheduled for Discoverer XXII (launched 30 March 1961 without Vehicle No. 1025) and the Department of Defense approved a news release on 10 January. (See Appendix E)

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[80] Summary of AFBMD Activities in Space, Mar 60, p A-8, and Apr 60 p A-8.

[81] Summary of AFBMD Activities in Space, Jun 60

[82] Summary AFBMD Activities in Space, Oct 60

In conjunction with an Aerospace Symposium, a press conference was held for Air Force Secretary Eugene Zukert on 28 August 1961. General Bernard Schriever "said that plans to fire a monkey into orbit in Discoverer XXII were called off at the last minute." Lieutenant General Howell M. Estes, Jr., who also attended added that the bioastronautics program had been given to the National Aeronautics and Space Administration in general and that it was important that the Air Force and NASA not duplicate efforts.[*83]

On 13, 14, 22 and 23 March 1961 in Hearings before the Committee on Science and Astronautics and Subcommittees Nos 1, 3 and 4, U. S. House of Representatives, 87th Congress, First Session, there was considerable

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[83*] UPI Press Release 28 Aug 1961

discussion about the duplication of effort by both NASA and the Air Force. One of the largest animal colonies in existence was at School of Aviation Medicine, Brooks Air Force Base, Austin Texas, and there was a facility for handling animal colonies at Holloman Air Force Base, New Mexico, and NASA had established its Office of Life Sciences on 1 March 1960. So the matter of "possible duplication of effort in the life sciences between NASA and the Department of Defense, particularly the Air Force," had been highlighted as a cause for concern by the congressional committees.x[84]

There was also, some international interest in the treatment and use of animals from foreign countries, as indicated in the approval of a DoD news release, 10 January 1961. The USAF Office of Public Information possibily anticipated questions or comments of foreign governmant inasmuch as "The State Department expressed a desire to be advised of any forthcoming release dates on this subject." Figure 4 shows the biomedical facilities at Vandenberg Air Force Base about the time that the life science aspects of the Discoverer program was deleted.

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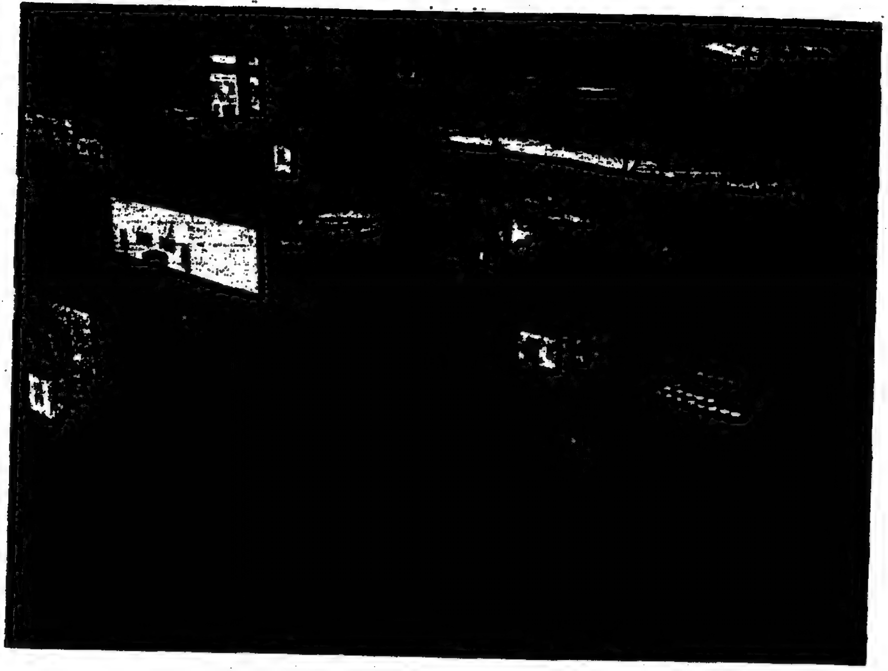
[84] x Hearings before the Committee on Science and Astronautics and Subcommittees Nos. 1, 3, and 4 U.S. House of Representatives, Eighty-Seventh Congress First Session on H.R. 3238 and H.R. 6029, Part 2



*Van type Biomedical facilities at Vandenberg Air Force Base. This laboratory is used for final check and preparation of animals prior to launch. Interior view of Biomedical van (below) showing some of the instrumentation racks used in monitoring the test animal.*

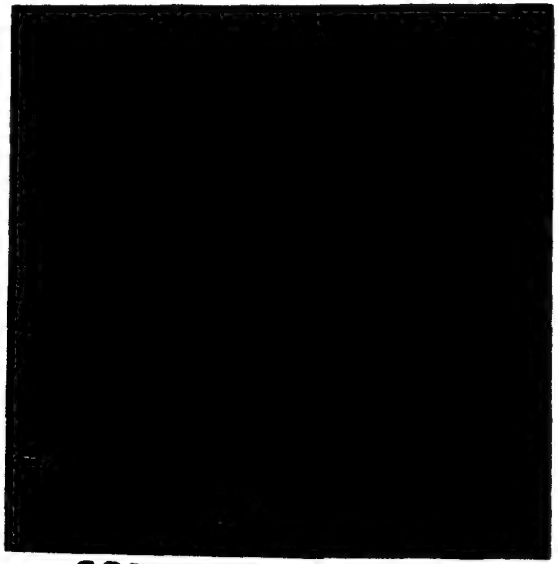


Figure 4.

Group 3

# DISCOVERER FLIGHTS AND FUNDING

Altoghther, there were 78 Discoverer launches--the first launch was on 28 February 1959 and the last launch was on 27 April 1964. Amendment No. 6, 20 July 1959, to ARPA Order No. 48-59, increased the 25-flight series to a 29-flight series. After Secretary of Defense transferred Samos, Midas and Discoverer from ARPA management to the Air Force, the Director of Advanced Technology, Headquarters USAF notified AFBMD of the status of funds for the three programs. Research, development, test and engineering funds for Discoverer FY 1960 was $56.003M and for FY 1961 was [redacted] AFBMD submitted new development plans for approval. Discoverer Development Plan, dated 15 January 1960, called for a 29-flight series and the revised financial plan showed $111.15M for prior years, $71.1M for FY 1960 and [redacted] for 1961. The Director of Defense, Research and Engineering, approved the plan in principle on 20 April 1960.[86]

On 20 July 1960, Headquarters, USAF asked for a revised 15 January 1960 Development Plan to reflect an increase from 29 vehicles to 37 vehicles, including two Discoverer radiometric launches for the Midas program.

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[85] Msg, AFDAT 93212, 22 Dec 59.

[86] Ltr, AFDSD-AT, 1 Jun 60, subj: Exploitation of Initial SAMOS Data.

Headquarters USAF gave verbal instructions to include in revision an increase to 41 vehicles rather than 37. Headquarters USAF had issued a message on 27 February 1960, in which it was reported that OSD had approved the essential "R&D Program for FY 60 as included in development plans as presented by AF-BMD." $71.1M had been approved for Discoverer.[87] on 1 September 1960, AFBMD submitted Change Number 1, dated 26 August 1960, to the 15 January 1960 plan to Headquarters USAF thru ARDC. The plan reflected a 41-vehicle program and changes in scheduling and funding.[88]

On 14 October 1960, Discoverer Program funds were increased by $6.0M from $49.1M to $55.1M. This increase was a reinstatement of a decrease in funds in the same amount made on 5 August 1960.[89]

Change Number 2, calling for a 41 vehicle program, superseded

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[87] Discoverer Program Chronology, 1 Jul 60 - 31 Dec 60, 24 Jan 61

[88] *Ibid.*;Msg, AFABF and AFDDP 73993, 271712Z Feb 60.

[89] Discoverer Program Chronology, 1 Jul 60 - 31 Dec 60, 24 Jan 61.

Change Number 1 by updating the schedule and funding, was prepared on 29 November 1960 and submitted to Headquarters ARDC on 27 December 1960. In January 1961, two vehicles were transferred to another program leaving 39. Later in January 1961, six additional vehicles were authorized and a new plan was requested.*[90]

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[90]* Discoverer Program Chronology, 1961

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Change Number 3 to the 15 January 1960 Development Plan, calling for a 45-vehicle program and additional funding was submitted on 2 May 1961. Headquarters USAF approved Change Number 3 on 7 September 1961.*[91]

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[91]* *Ibid*.

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On 4 December 1961, Secretary of the Air Force added ten vehicles to the Discoverer Program. The schedule provided for 3 each in September and October, and two each in November and December 1962.*[92]

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[92]* Msg, SAFS 83174, 042206Z Dec 61

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Change Number 4, calling for a 60-vehicle program was submitted for approval on 5 February 1962. Headquarters USAF approved the change--it also included FY 1962 funds in the amount of [redacted] and FY 1963 funds in the amount of [redacted] on 19 March 1962.[93] ~~Figure No. 3 is a summary of fund requirements as of 30 June 1962.~~

On 10 July 1962, Change Number 5 to the 15 January 1960 Development Plan was submitted to Headquarters USAF. The plan called for a 65-vehicle program through calendar year 1963.[94]

The Director of Science and Technology, Headquarters USAF, made Space Systems Division responsible for system preparation, launch, tracking, control and data recovery operation of a Special Radiation Measuring Satellite Project known as STARAD, and assigned Thor booster Number 356 to the Discoverer Program for a launch in October 1962. The booster was used on 5 November 1962.[95]

In September 1962, Under Secretary of the Air Force directed that the Discoverer Program be revised to provide for 22 vehicles scheduled for launch through December 1963 as follows: September 1962, 3; October 1962, 1; November 1962, none; December 1962, 1; January 1963, 1 and February - June 1963, 2 each month; July - December 1963, 1 each month. Headquarters USAF also directed that financial and program portions of the development plan be revised to correspond to the schedule. In addition, Headquarters USAF requested immediate use of Thor boosters (Model DSV-2C) with three solid propellant rocket motors ~~strapped to its outside shell to furnish more thrust also known as~~ TAT (Thrust Augmented Thor).x[96] The first TAT launch was accomplished 28 February 1963.

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[93] History of Program 162 for CY 1962.

[94] *Ibid*.

[95] Msg, AFRST 82769, 14 Sep 62; Discoverer Launch Data Digest (Appendix B

On 2 November 1962, a new Change Nomber 5 to the 15 January 1960 Development Plan was submitted to Headquarters USAF. The plan entirely superseded the previous Change Number 5, dated 5 July 1962. The new change increased the number of vehicles to a 76-vehicle flight series and required modification of the Discoverer vehicle and Vandenberg Air Force launch complexes.[x][97]

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[96] x Msg, AFRAE-S-4 82037, 12 Sep 62; History, The Space Systems Division - Background (1957-1962) Vol I, p 29.

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97 x Program 162 Chronology CY 1962.

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On 4 December 1962, the Under Secretary of the Air Force directed Space Systems Division to proceed with the following launch schedule, beginning January 1963: January, 1; February to December, 2 each month; January to June 1964, 1 each month; July to December 1964, 2 each month.[x][98]

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98 x Msg, AFRAE-S-4 99514, 4 Dec 62.

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On 19 April six additional flights were added to the Discoverer Program, making a total of 45 flights scheduled beginning July 1963.[x][99]

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99 History Program 162, 1 Jan - 30 Jun 63.

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However, only 12 of the 45 vehicles were launched. Sixty-seven* of the 76-flight series described in Change Number 5, 2 November 1962, to 15 January 1960 Development Plan, were launched prior to 1 July 1963.

On 3 March 1964, the Under Secretary of the Air Force terminated the Discoverer Program effective 30 April 1964. The decision was made after a careful evaluation of the results achieved versus the resources expended. The program had made important contributions in advancing knowledge of the space environment and in proof testing the standard Thor booster (DM-21), and the Thrust Augmented Thor (TAT) and the standard Discoverer vehicle.[x100] All remaining resources were transferred to other Space Systems Division programs or to Secretary of Air Force Special Projects organizations.[x101]

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* This number included the attempted first launch on 21 January 1959.

At the time, there were two programs, Programs 770 and 241, both quite new Air Force Programs that were in the definition stage and both had urgent requirements for the Thor booster and the satellite vehicle.[x102]

Discoverer also had a program number designation. Program 162 was assigned to the program effective 6 August 1962.[x103] Prior to that time

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[100] x Msg, SMF 3-3-2, 03/2229Z Mar 64

[101] x Historical Report, Program 162, 1 Jan - 30 Apr 64

[102] x Msg, SSG 6-3-7, 6 Mar 64.

[103] x Ltr, AFSC (MSFA), subj: Assignment of Identification Nomenclature of Selected Military Space Programs, 19 Jul 62.

the number designation was 622A, that was assigned approximately January 1962.[x104]

Besides the Mark I live passengers launched on Discoverer III, there were other biomedical experiments designed to measure radiation levels and effects of weightlessness conditions so that environmental effects on biological systems could be determined. Experimental packages including living cells, ampules of algae, bread mold, bacterial spores, essential life substance such as gamma globulin and albumin. Discoverers XVII and XVIII carried such biopacks.[x105]

Other Discoverer payload packages were generally as follows: (1) advanced engineering test package (AET); ~~(2) Heavyweight Advanced Engineering Test package (AET-H)~~; (2) Lightweight Advanced Engineering Test (AET-L); or specialized equipment, such as a radiometer package.[x106]

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104x AFSC FY 63 & FY 64 Consolidated Program Guidance, 10 Jan 62.

105x AFBMD Chronology, Office of Bioastronautics (WDZB) 1 Jul - 31 Dec 60.

106x LMSD Satellite Systems Data Book, Discoverer Program, Sec I, p 1.0.1, 15 May 1961, as amended.

(C/Gp3) Discoverers XIX, XXI, XLVII, LII and LXXIII carried radiometric payload packages for the Midas program.[x107]

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107 x Program 461 Historical Monograph, LMSD, 15 Jun 65, Sec 4.

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Discoverer XXXVI, launched on 12 December 1961 carried OSCAR I (Orbiting Satellite Carrying Amateur Radio), a 10-pound robot, hand built by a group of amateur radio enthusiasts, that returned a morse code "Hi" to radio hams around the world.[x108]

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108 x AP and UPI News Report, 12 Dec 61.

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Discoverer XVII, launched on 12 November 1960 and recovered on 14 November 1960, carried the first official satellite mail.* A letter signed by Air Force Chief of Staff, General Thomas White and addressed to Secretary of Defense Thomas Gates was in the recovery capsule. In the space letter to Secretary Gates, General White wrote:[x109]

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109 x Summary of AFBMD Activities in Space, Nov 60.

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> This is the first time that letters have been sent by a satellite and is in the tradition of airmen who less than 30 years ago pioneered the first use of air mail.

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* History, 1st Strategic Aerospace Division, VAFB, 1957-1961, dtd Apr 62 made note of messages of jinxes and bad luch sent up in Discoverer III by persons who estimated the odds against capsule recovery were 1000 to one.

launched on 17 September 1961, carried Vela Hotel piggyback payload equipment which consisted of scintillator X-ray detectors and solid state spectrometers. Discoverer XXXIV, launched on 5 November 1961 and Discoverer XXXVI, launched on 12 December 1961, carried Vela Hotel piggyback payload equipment X-ray detector plus a neutron and gamma ray detector. The Vela Hotel Program was an ARPA program designed to conduct space-based studies for verifying "the feasibility of X-ray gamma ray, and neutron detector applications in far-earth radiation detection systems which are intended to detect and identify high-altitude nuclear explosion phenomena.*[110]

A description of the recovery capsule used for other than life support was as follows:*[111]

> The recovery capsule consists of ejection equipment for orbit release and trajectory modification, and recovery equipment for recovery detection and pickup. Upon separation from the parent vehicle, the reentry vehicle is placed in a spin mode through the use of a cold gas spin system. A solid motor retrorocket (about 1200# thrust) fires to supply the required de-orbit velocity. Upon completion of retrofire, a cold gas de-spin system counteracts the previously imparted spin. The spent retrorocket thrust cone is ejected. Gravity switches control the deployment of the parachute (squib fired parachute cover) and the release of an ablative reentry heat shield. A drogue chute pulls out the reefed 30 foot main chute and then is released. The main chute deploys about 55,000 [feet]. Aboard the reentry capsule are telemetry and radio beacon tracking aids.

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[110] * Historical Report, Vela Hotel, 1 Apr-31 Dec 61.

[111] * 622A Program Summary - Historical Report, 23 Jul 62.

Of the 78 Discoverer launches, 61 Discoverer Vehicles were orbited, of which 40 vehicles were recovered, 34 by air recovery and 6 by sea recovery. Five payloads, four of which were orbited were nonrecoverable types.[112]

The 6593d Test Squadron (Special), with the help of a RC-121D (Aerospace Sentinel), a flying radar station, and a Navy helicopter made the first recovery when it recovered the Discoverer XIII Capsule on 11 August 1960. Major Francis P. O'Hop (Seattle, Washington) commanded the RC-121D that gave the final directions for the capsule recovery. First Lieutenant Joe B. Grace (Overton, Texas), Senior Radar Director, of the 964th Squadron (ADC) of the 552d Airborne Early Warning and Control Wing (ADC), directed all aircraft and a Navy vessel, Haiti Victory, to the vectoral position of the capsule.[113]

By radar guidance, Captain L. W. Shinnick and his crew of Pelican Two signted the capsule in the water approximately two minutes after the capsule had hit the water. Pelican One, Three and Four arrived only a few minutes after Pelican Two. The C-119C crews marked the impact area with sea dye marker and smoke bombs and circled overhead until helicopters launched from the satellite recovery ship, the United States Navy Ship "Haiti Victory" arrived. The ship, 100 nautical miles away from impact area, released its two helicopters about 50 miles from target position. Helicopter Two dropped a frogman into the water to secure the capsule to the hoist cable. The helicopter delivered the capsule to the Haiti Victory as Helicopter One recovered the frogman. On the following morning (Friday, 12 August) when the Haiti Victory was about 50 miles south of Pearl Harbor, a courier from the 6594th Test Wing arrived aboard and took charge of the capsule for delivery to Hickam AFB. At Hickam AFB, the capsule was transferred from the helicopter to a C-130 that delivered the capsule to the Lockheed satellite test division at Sunnyvale, California, so that certain instrumentation could be removed for evaluation. From Sunnyvale, the capsule was flown to Washington, D. C., where it was viewed by General Thomas D. White, Air Force Chief of Staff, and General

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[112] x Summary of Discoverer Launches (Appendix B

[113] x News Release: 1-4. Office of Information, Hq 552nd Airborn Early Warning and Control Wing (ADC).

Bernard A. Schriever, Commander, Air Research and Development Division, on Saturday (13 August). The capsule was exhibited to President Eisenhower, the Secretary of Defense and their top Air Force Advisors, as well as military representatives from ARDC, AFBMD, and the 6594th Test Wing. The capsule was placed on display throughout the country until December when it was returned to Sunnyvale for final cleanup and polish so that General White could present the capsule to the Smithsonian Institution on 17 December 1960 at the Wright-Day Dinner ceremonies, Sheraton Park Hotel, in Washington, D. C.[114]

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[114] ~~x~~ History of 6594th TW (Satellite) (ARDC), 1 Jul-31 Dec 60; Summary of AFBMD Activities in Space, Aug 60; Discoverer XIII Life Cycle, presented by 6594th TW (Satellite) (ARDC); Msg, RDEI 8-12-19, 8 Dec 60.

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On 16 December (Friday), Major General Osmund (Ozzie) J. Ritland presented Discoverer XIV capsule, the first air-snatch recovered vehicle--recovered 18 September 1960--to the Air Force Museum at Wright-Patterson Air Force Base, Dayton, Ohio, during the Wright-Day dinner ceremonies. The capsule had been placed on display at the Air Force Academy during the ~~month~~ of November.

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DRAFT HISTORY

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# APPENDIX A

# BIOASTRONAUTICS-DISCOVERER
# BOARD REPORT

22 December 1959

CLASSIFICATION OF THIS DOCUMENT
WILL BE DOWN GRADED TO Uncl
UPON REMOVAL OF ENCLOSURES.

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SECRET

WDZ-1-7

# BIOASTRONAUTICS-DISCOVERER

# BOARD REPORT

22 December 1959

copy #3 of 3

DOWNGRADED AT 12 YEAR
INTERVALS: NOT AUTOMATICALLY
DECLASSIFIED. DOD DIR 5200.10

SECRET

SUBJECT: Report of Proceedings of DISCOVERER-Biomedical Board Convened Under Special Order Number 20 Dated 27 November 1959 as Amended.

TO : Commander
Air Force Ballistic Missile Division
Air Force Unit Post Office
Los Angeles 45, California

## I. AUTHORITY AND BOARD ACTION:

On 2 December 1959, a Board appointed under AFBMD Special Orders Number 20, Exhibit A, was convened at 0900 hours in Room 205, Building 4, Hq, Air Force Ballistic Missile Division. The Board met in daily session to hear briefings and testimony from a list of witnesses, Exhibit B.

The following Board members were present on all days:

| | | |
|---|---|---|
| Colonel Paul E. Worthman | Hq AFBMD | President Voting |
| Colonel John E. Pickering | Hq SAM | Member Voting |
| Lt. Colonel James S. Seay | Hq BMC | Member Voting |
| Major William H. Weaver, Jr. | Hq AFBMD | Member Voting |
| Dr. Fred Berner | WADC (Representating Hq ARDC) | Member Voting |

The following Board member was absent on all days:

| | | |
|---|---|---|
| Lt. Colonel Raymond E. Zelenka | Hq AFBMD | Member Voting |

On 8 December 1959, at 1430 hours, the Board recessed to begin preparation of its findings and report. Verbatim testimony was taken by the Board; when this testimony plus supporting documents are in final form they will be Exhibit O of this report.

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

## II. MATTERS INVESTIGATED:

In a directive, Exhibit C, subject, "Investigating Committee", to the Deputy Commander/Space Systems, dated 29 October 1959, the Commander AFBMD outlined matters to be investigated, as follows:

A. Determine the facts regarding specific allegations challenging the technical adequacy and management of the biomedical portion of the DISCOVERER system.

B. Make recommendations regarding the management structure of the present biomedical program and possible future programs.

C. Make specific technical recommendations regarding the biomedical shots within the DISCOVERER flight series.

## III. BACKGROUND INFORMATION:

A meeting was held at the Air Force Ballistic Missile Division on 14 January 1958 for the purpose of discussing Lockheed Proposal #36899 dated 14 January 1958 which recommended acceleration of the WS 117L effort. The object of this acceleration was to obtain early reconnaissance information, using THOR-boosted vehicles and a recoverable capsule technique. As a result of this meeting Contract No. AF04(647)-181 was issued to the Lockheed Missile and Space Division on 25 January 1958 (work statement extracted as Exhibit D), calling for four flights scheduled for October, November, December 1958, and February 1959.

On 28 February 1958, see Exhibit E, the Director of the Advanced Research Projects Agency cancelled the reconnaissance aspects of the THOR-boosted phase of WS 117L and directed the Air Force to use these vehicles for biomedical experiments.

On 19 March 1958, the LMSD contract was re-oriented to include development of a recoverable capsule to accommodate a biomedical package, which is now referred to as a "life support system." The completed capsule was to be ready for flight test no later than 30 November 1958.

On 22 May 1958, the Commander ARDC sent a letter, Exhibit F, subject, "Support of Bioastronautics Program," to the AFBMD. This letter assigned Brigadier General Don Flickinger additional duty as Special Assistant to the Commander AFBMD for Bioastronautics, stating that General Flickinger would "be responsible for the direction and coordination of all the biomedical aspects of projects assigned to your organization." In addition, the letter assigned two biomedical project officers to the AFBMD, and directed the use of other competent individuals and groups in ARDC and elsewhere in an advisory role, as needed.

On 6 May 1958, see Exhibit G, the LMSD designated the General Electric Company as the subcontractor for the life support system. It was brought to the attention of all participating agencies that primary technical competence in the bioastronautics area was actually within the Air Force, and special arrangements, see Exhibit H, made the technical competence of the School of Aviation Medicine, the Aerospace Medical Laboratory (WADC), and the Aeromedical Field Laboratory (AFMDC) available to the contractor.

The G.E. life support system development comprised two models; the Mark I version, designed to carry four mice into orbit, and the Mark II version which was to have a small primate as its passenger. The first Mark I life support system, originally scheduled to fly on 30 November 1958, flew with "mechanical" mice in DISCOVERER III on 3 June 1959. The second Mark I was scheduled to fly in December 1958 and flew with live mice aboard in DISCOVERER IV on 25 June 1959. Any subsequent references in this report to the G.E. life support system are specifically directed toward the Mark II version.

The Mark II life support system, see Exhibit I, contains the following major components: life cell, air conditioner, oxygen system, electrical system, camera, feeder, air regeneration system, and clock.

The first testing of the life support system as a unit began at LMSD on 1 April 1959. Thirteen tests, see Exhibit J, of this general type have been run to date; only one of these can be considered to have met its objectives. As the testing program proceeded, it became increasingly evident to all participants that the development was encountering serious technical difficulties. These problems were reflected further in fiscal problems (roughly $2.3 million has been spent on this project to date), and in schedule slippages which are now amounting to about one year.

During the past several months numerous allegations regarding the reasons for these technical, fiscal, and scheduling problems have come to the attention of AFBMD staff members. On 29 October 1959, the Commander AFBMD directed the establishment of a Board of officers to determine the facts with regard to the following allegations:

A. "The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the DISCOVERER series."

B. "Management of the biomedical test program by AFBMD, LMSD, and G.E. is grossly inadequate."

C. "Biomedical program costs being incurred by G.E. are too high and are not being subjected to proper management control."

D. "There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program."

E. "Civilian corporations, specifically G.E., are using their particular positions in the biomedical program as a means of building their competence in the biomedical area."

Additionally, the Commander AFBMD directed the Board to make recommendations regarding:

A. The management structure of the present and future biomedical programs.

B. The technical course of action to be followed for the present biomedical program shots within the DISCOVERER series.

## IV. GENERAL FINDINGS:

### A. Technical Aspects of the Life Support System Development.

Witnesses appearing before the Board were in general agreement that the life support system design and test performance have been - until very recently - grossly inadequate. An inordinate amount of under-designed and non-qualified equipment has found its way into the system. Outstanding offenders in this category have been such items as oxygen regulators, the air conditioning unit, the cooling fan, the tape recorder, the camera, the timer, the feeder, the sintered absorbing plates, the electrical circuitry, and the outer housing or case.

Ironically, some of the most expensive items in this list were probably not required for successful system performance. For example, School of Aviation Medicine witnesses testify that they offered G.E. a feeder which had been built for less than $2.00 (cost of materials). The General Electric Company spent in excess of $78,000 re-inventing a feeder, eventually abandoned the effort, and is now using the School of Aviation Medicine's version. The Board noted that it is a clinical fact that the primate will not require nutrition during the flight period; the feeder appears to be "gold-plating" of the primary purpose of the life support system.

The camera is a second case in point: the Board was unable to learn who had specified the system's camera, which takes an oblique picture of a portion of the exposed chin of the primate (the rest of his face being covered by a mask). Over $100,000 has been spent in developing this special camera; it has been a difficult, time-consuming exercise, which has yet to be completed. It was noted with interest that the camera's operation requires a light to be burning at all times in a capsule which is already over-heated and under-powered.

While it is true that the adequacy of design was hampered in part by the absence of exact environmental data at flight altitude, it is the opinion of the Board that other factors were more important contributors to the life support system's inadequate design. Among these are:

1. From the very beginning, a general lack of appreciation by the contractors - prime and sub - of the complexity of the task.

2. Total inexperience on the part of both the prime contractor and the subcontractor in a difficult technical area.

3. Lack of a proper, thorough researching of the basic life support system problem.

4. No singleness of purpose in keeping the life support system as simple as possible.

5. Lack of application of scientific method in proceeding from the simple to the complex in building the life support system.

6. A curious conviction, on the part of the subcontractor's project leader, that his responsibility terminated with ground demonstration, rather than with actual flight test.

7. Inadequate provisioning of spare parts.

8. Lack of quality control of life support system equipment.

9. Lack of corrective procedures for rectifying design equipment errors and preventing identical recurrences of equipment failure.

B. Managerial Aspects of the Life Support System Development.

Having examined the technical problems associated with the life support system, the Board turned its attention to the management history of the project. Here, again, there was consensus among the witnesses that the management of this program had been exceptionally unsatisfactory.

The evidence presented to the Board indicated that a number of primary management decisions were either not made, or, if made, were not generally known to the project participants. For example, there is no clear indication of formal, official evaluation of the importance of the project. Was the life support system as important - in terms of national objectives - as ballistic missile work at the AFBMD? Was the recovery of the first living animal from satellite orbit as important an objective, and to be accorded the same all-out emphasis, as the recovery of the early ICBM/IRBM re-entry bodies?

While it is true that this project was considered to be a "crash", high-risk development, there is evidence before the Board leading to the inference that this project was not considered to be as important as other "crash", high-risk developments at the AFBMD. This view is based on the consideration that many of the key management principles applied to the ballistic missile program by the AFBMD were not used in this project.

1. A rigidly stipulated dollar ceiling was accepted in conjunction with a "crash", high-risk development to be performed in a relatively unexplored technical area. The Board has no indication that this combination of factors was protested by anyone (other than G.E.) as inherently contradictory and impractical.

2. The AFBMD's practice of deliberately establishing competitive sub-system developments in difficult technical areas was not invoked.

3. It is an accepted AFBMD practice to place officers in semi-permanent or permanent residence at those contractors' plants where serious technical problems are envisioned or experienced. It is noteworthy that in spite of the alarming state of the life support system development program no such action was taken with respect to General Electric Company.

4. In undertaking "crash", high-risk ballistic missile programs the AFBMD has considered the associate contractor system to be necessary and essential to maintaining tight technical, fiscal, and management control. The DISCOVERER system, by contrast, was organized along traditional prime contractor lines, making the General Electric Company less accessible to the AFBMD for life support system work than it is for re-entry body work.

Note

A second basic decision which the Board has been unable to identify in the project documentation or testimony is whether the School of Aviation Medicine was seriously considered as a possible developer of the life support system. The Board was deeply interested in the development history of a life support system which the SAM has fabricated for the NASA for use on experiments such as the recent biomedical flight at Wallops Island, and took particular note of testimony by the School witnesses that they had been eager to do similar work for the AFBMD. The School's witnesses estimated development costs of $120,000 vis-a-vis approximately $2.3 million already spent on the G.E. effort; if this estimate should be in error by a factor of five, it still leads to the conclusion that it would have been prudent to use the School as a second source.

The third major decision which is lacking in project history is the development of a firm position as to who at the AFBMD was in charge of what. The following chronology illustrates this observation:

1. 22 May 1958. In a letter to the AFBMD, subject, "Support of Bioastronautics Program," see Exhibit F, the Commander ARDC stated that Brigadier General Don Flickinger was being "assigned the additional duty of Special Assistant to the Commander AFBMD for bioastronautics." The purpose of this assignment was to provide the Commander AFBMD with an "in-house primary biomedical technical competence and authority." General Flickinger was made "responsible for the direction and coordination of all the biomedical aspects of projects assigned to [the AFBMD]". The Commander AFBMD was assured that "control of all aspects of this work will rest with your organization."

2. 6 June 1958. In a DF to the AFBMD, subject, "Biomedical Aspects of the Ballistic Missile Program," see Exhibit K, the Assistant

Deputy Commander/R & D, Hq ARDC, stated that "all research and development efforts contemplating the use of biological payloads on board missile or space vehicles will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative." In addition it stated that a bioastronautical organization at the AFBMD would "obtain over-all approval and coordination of the life-sciences aspect" of such projects. An unusual administrative and command-jurisdictional feature of this letter is that in it one Deputy Commander (the DC/Research and Development) at Hq ARDC presumes to assign roles and functions to a subordinate unit within the organization of another Deputy Commander (the DC/Ballistic Missiles) at Hq ARDC.

3. 12 August 1958. The Assistant Deputy Commander/Research, Hq ARDC, in a letter, subject, "Responsibilities of School of Aviation Medicine in the ARDC Biosatellite Program, Subsystem L WS 117L," see Exhibit L, advised the Commander AFBMD that representatives of Hq USAF, Hq ARDC, Air University (School of Aviation Medicine), Air Force Missile Development Center, and Wright Air Development Center had reached agreement concerning the technical responsibilities of the School of Aviation Medicine in its support of the biosatellite program, and enclosed a statement of policy for the benefit of the AFBMD. The policy statement was signed by Brigadier General Don Flickinger as the Director of the Life Sciences Directorate at Hq ARDC and states that the School of Aviation Medicine will provide biomedical criteria to the General Electric

Company, will consult on biomedical test programs and evaluate biomedical test results, and will provide continuous biomedical and biophysical technical standards liaison and consultation to the contractor. "All other decisions relative to test responsibility and conduct, engineering requirements, scheduling, time and costing functions and general welfare of the program will remain with BAD [the Bioastronautics organization with the AFBMD] or their properly designated representatives, and BAD decisions are final." In addition "direct contact is authorized between SAM and contractor." From a jurisdictional viewpoint, this correspondence was even more unorthodox than its predecessor, for now a Directorate Chief in the organization of one Deputy Commander (the DC/Research) at Hq ARDC was issuing instructions regarding roles and functions of a subordinate unit within the organization of another Deputy Commander (DC/Ballistic Missiles) at Hq ARDC. It is also noteworthy, that the Director of the Bio-Astronautics Directorate at the AFBMD was not aware of the existence of this document until it was brought to his attention by the Board, early in December 1959.

4. The AFBMD's tacit acceptance of these directives is reflected in a letter from the AFBMD's Director for WS 117L to the Lockheed Aircraft Corporation, subject, "Contract 04(644)-181, Internal Air Force Responsibilities Concerning Biosatellite Programs," dated 4 September 1958, see Exhibit H, which quoted the essence of General Flickinger's policy statement and informed LMSD that "the Bioastronautics Division (BAD) has been given managerial responsibility

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for all animal biosatellite programs and will act as technical direction to the contractor on biomedical aspects."

5. 13 August 1959. On this date, the Deputy Commander/ Military Space Systems published a series of Functional Statements, see Exhibit M. Among these was one for the Director of the DISCOVERER Satellite System, which contained the following key statement: "Responsible to the Assistant Deputy Commander, Space Systems, for the integration of all research, development, and test aspects of the DISCOVERER Satellite System."

6. 26 October 1959. The Assistant Deputy Commander/Space Systems, in a letter to the Deputy Commander/Military Space Systems, subject, "Management of DISCOVERER Biomedical Program," see Exhibit N, stated " . . . I must as a matter of policy support the view that the Director, DISCOVERER Satellite System is basically responsible for the quality of all aspects of the DISCOVERER Program and, accordingly, must have the authority which is required to meet the responsibility assigned to him."

In an attempt to clarify management roles the Board queried each witness regarding his concept of responsibility for conducting the project. The following responses illustrate the diversity of opinion in this important area:

1. The Director of the DISCOVERER system development - Lt. Colonel Battle - believes that General Flickinger and the Director of the Bioastronautics Directorate (presently Lt. Colonel Cole) were

responsible for the life support system development until 13 August 1959, when the new Functional Statement Book appeared. Lt. Colonel Battle states that since that date he has had overall responsibility for all aspects of the DISCOVERER system. It is his opinion that General Flickinger is still the Special Assistant to the Deputy Commander AFBMD for Bioastronautics.

2. The Assistant Deputy Commander for Space Systems - Colonel Oder - agrees with Lt. Colonel Battle's interpretation of management responsibility, and testifies that he has no knowledge which would lead him to believe that General Flickinger has vacated the post of Special Assistant to the Commander AFBMD for Bioastronautics.

3. The Assistant Deputy Commander for Military Space Systems - Colonel Evans - also agrees with Lt. Colonel Battle's interpretation of his responsibilities. While he has no definite knowledge of a change in General Flickinger's role as Special Assistant to the Commander AFBMD for Bioastronautics, he speculates that some change may have occurred during the past few months as a result of the reorganization of the ARDC.

4. The Director of the Bioastronautics Directorate - Lt. Colonel Cole - testifies that he is responsible to the Commander AFBMD for the managerial and technical aspects of the biomedical portion of the DISCOVERER program.

It is a matter of fact that General Flickinger's appointment as Special Assistant to the Commander AFBMD was terminated by Department of the Air Force Special Order A-1990 on 18 November 1958; however, this fact is confusing, rather than clarifying, to the central issue. Is the Commander of AFBMD still bound by the provisions of the 6 June 1958 DF, a document which has never had jurisdictional legality, but which was not protested by the AFBMD? Was it the intention of the Deputy Commander/Military Space Systems, in the 13 August Functional Statements Book, to place the DISCOVERER Director in charge of all aspects of the DISCOVERER program? If so, what is the meaning of the expression "responsible . . . for the integration of all . . . aspects?" What is the status of the 26 October 1959 letter from the Assistant Deputy Commander/Space Systems to the Deputy Commander/Military Space Systems regarding the interrelationships of the DISCOVERER - Bioastronautics offices?

As would be expected, the absence of a strong, single, clearly designated, and universally-recognized AFBMD leader for the life support system encouraged the development of many management and technical difficulties, all of which were symptomatic of a central problem. The jurisdictional sparring which took place between LMSD and G.E. early in the program could and should have been stopped as soon as it began. The over-willingness of G.E. to respond to technical suggestions from anyone except the prime contractor could have been eliminated by the most elementary exercise of discipline. It would have been easy for a responsible agent to develop and enforce an official document which specified agency responsibilities, agency spokesmen, and inter-agency channels. Test protocols - rigidly enforced - would have done much to eliminate all-night "shall-we-proceed" sessions where decisions were made by last-minute plebiscites. Explicit count-down procedures would have spared the life support system test procedures from being characterized as "utter chaos" by the DISCOVERER test controller. A strong agent would have advised the AFBMD of any difficulties which were beyond his capability to resolve; the Board would certainly not have been exposed to contractors' briefing charts listing AFBMD and AFBAD (an old symbol for the Bioastronautics Directorate) as two separate agencies, both of whom must agree to a matter before the contractor may proceed!

## C. Present Status of the Life Support System Development.

In June 1959, while visiting Vandenberg Air Force Base to observe count-down procedures, Dr. William H. Godell, of the Advanced Research Projects Agency, observed the problems which were developing in the life support system area. Upon his return to Washington, Dr. Godell contacted corporate-level G.E. officials, advised them of his deep personal concern, and asked them to undertake immediate remedial action. In August 1959, G.E. sponsored an intensive in-house review of the technical and managerial problems associated with its support of the DISCOVERER program; this investigation resulted in sweeping changes in the philosophy of, and actual conduct of, development and testing of the life support system. The Board inquired carefully into the details of this "new look" and was favorably impressed by the results to date, as well as plans for the future. Principal witnesses were unanimous in indorsing the technical direction which the new G.E. management is giving to the program; LMSD representatives stated that a wholesome air of cooperation and responsiveness now exists between themselves and the General Electric Company. There is substantial evidence to justify, for the first time, a feeling of optimism regarding the possibility of G.E.'s delivering a flight-worthy life support system within the next few months.

## V. SPECIFIC FINDINGS:

The Commander AFBMD instructed the DISCOVERER-Biomedical Board to consider five specific allegations and to make recommendations on three subjects, see Exhibit C. This portion of the report deals with the Board's findings in response to these instructions.

A. Allegation A. "The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the DISCOVERER series."

1. Discussion: The prime objective of the biomedical portion of the DISCOVERER series is the successful launching, orbiting, re-entry, and recovery of a live specimen. Performance to date in the test evaluation of the life support system strongly suggests Allegation A to be true. Testimony before the Board reveals that of thirteen evaluation and/or acceptance tests, only one could be considered to have reasonably demonstrated criteria for supporting the DISCOVERER program properly. Additional evidence from technically qualified scientific personnel leads to the conclusion that there has been an inordinate amount of faulty equipment integrated into the life support system, i.e. the oxygen regulators, the air conditioning unit, cooling fan, tape recorder, camera, timing mechanism, animal feeder, sintered metal absorber holders, electrical circuitry, etc. It was obvious, early in the proceedings, that inexperience, coupled with the unavailability of limiting physical (environmental) data, contributed to poor design.

For much of its history the life support system development did not follow the basic principles of scientific method. It is germane to the scientific method that clear-cut objectives be rigidly defined at the very beginning and throughout the project. Furthermore the absolute minimum number of pieces of data-gathering equipment should be bench tested exhaustively before they are incorporated into the total system. As each item passes its design criteria tests, further sophistication and instrumentation may be pursued logically, but only to the extent that system objectives are enhanced. Great care must be exercised to avoid over-design and over-complication in any system. Problem items of limited utility should be challenged early in the program and deleted as soon as possible in any urgent program. These simple methods of procedure have not been evidenced in this program - specifically in such items as camera and feeder performance, viability sensing, and in some electrical circuitry.

The Board is pleased to report that a careful in-house systems design review and critique were instituted at the General Electric Company between 27 August and 6 October 1959. The findings are now being integrated into the life support system design, to correct deficiencies and improve maintainability and accessibility. There has been a clear recognition of improper methodology and quality control; corrective procedures are being instituted to avoid recurrence of equipment failures. It is the opinion of qualified engineers that the life support system can be brought to a flight-worthy state in the near future.

2. Conclusion: Until a life support system has been completely bench checked and has successfully passed a complete laboratory count-down to simulate as closely as possible the problems of launching, orbiting, re-entry, and recovery, with thermal and noise profiles superimposed, and all integrated into the expected time sequence of a realistic mission (54 hours), a scientific capability to support the biomedical mission of the DISCOVERER series has not been demonstrated. The Board believes that the technical and managerial re-orientation of the program at G.E. is moving the development properly in the direction of such a demonstration.

B. Allegation B. "Management of the biomedical test program by AFBMD, LMSD, and G.E. is grossly inadequate."

1. Discussion: Having determined that the overall management of the life support system was under the superficial supervision of Hq ARDC personnel from project inception to sometime between November 1958 and August 1959, and perhaps to the present, the Board believes that this allegation should be expanded to provide a share of management responsibility to this particular group (Hq ARDC).

The Board's findings show three major factors contributing to the mismanagement of this project:

a. Representatives of the AFBMD, LMSD, G.E., and Hq ARDC did not research the assignment thoroughly enough to determine the state of the art of the parameters inherent in the project.

b. As a result, very unrealistic time schedules were set up and agreed to by Hq ARDC, the AFBMD, LMSD, and G.E. Fiscal planning exactly paralleled schedule planning.

c. Despite attempts at non-conventional arrangements, the prime responsibility for the project, for all intents and purposes, rested with the AFBMD. The AFBMD failed to identify one person who would be accountable for the project: a man whose decisions would be irrevocable except by the Commander AFBMD. Differences of opinion as to who was responsible for the project should have been resolved as soon as they arose. The fact that this was not done encouraged irregular managerial processes and separated responsibility from authority.

The following factors also contributed very definitely to the unsatisfactory state of the program as it existed prior to August 1959:

a. Lack of communication

b. Lack of cooperation

c. Lack of coordination

d. Lack of quality control practices

e. Failure to identify specifically the responsibilities of contributing agencies - in particular, Air Force agencies.

f. Poor design practice on the part of G.E.

g. Instability of design

h. No firm policy concerning spare parts.

i. Failure of G.E. to follow accepted industrial practice, which separates manufacturing and inspection responsibilities.

2. Conclusion: Although the testimony shows inadequate

management of the life support system by Hq ARDC, the AFBMD, LMSD, and G.E. practically from project inception in February 1958 until August 1959, the Board takes note of the recognition of an unsatisfactory state of affairs by the principals and believes that corrective actions already taken by LMSD and G.E., together with those recommended to be taken by the AFBMD in Section V, Part F, 2a and b of this report will result in an acceptably managed project in the future.

C. Allegation C. "Biomedical program costs being incurred by G.E. are too high and are not being subjected to proper management control."

1. Discussion: In reviewing the testimony before the Board, it was found that the allegation was improperly stated. All costs incurred are proper; however, it is believed that the original estimate by G.E. was not great enough to do the work in question.

The original contract, covering the period from February 1958 to projected completion in October 1959, was negotiated in the amount of $4.3 million. This covered much more than the life support system. While G.E. was verbally directed to commence work in February 1958, it was August 1958 before a Work Statement was prepared and a Letter Contract issued to General Electric by Lockheed Missiles and Space Division. The cost to date on the total G.E. effort now amounts to approximately $6.5 million, of which approximately $1.5 million has been identified as overrun. There is an additional amount reflected in a current G.E. proposal to Lockheed for $3.0 million which has not been negotiated to date. It is LMSD's position that these costs generally reflect work which was contracted for under the original contract and, as such, can be construed in the main to be additional overrun. The principal costs related to the $3.0 million proposal are from Thiokol Corporation in the amount of $335 thousand for retro-rockets, to the Burmite Company in the amount of $174 thousand for spin rockets, and for prime equipment and spares in the amount of $274 thousand. An item called Support Engineering has been included in the amount of $1.295 million. The General Electric Company agrees that it under-estimated the scope of the job to be done both from a standpoint of cost and time required. This in itself would lead one to think that the costs being incurred by General Electric are too high.

There are two specific items: namely, a feeder and a camera, which reflect costs much greater than one would have expected for items of their nature. The camera has been procured by G.E. from the Bulova Watch Company at a cost of $192 thousand; the cost of the feeder developed by General Electric amounts to $78 thousand. With respect to the camera, the School of Aviation Medicine witnesses state that in their opinion this item is not needed and should not have been included in the life support system. The feeder presently used by the General Electric Company is not the feeder for which the costs have been incurred by G.E., but one which was fabricated by the School of Aviation Medicine. School personnel believe that a feeder could have been adequately designed and produced for less than $1,000.

These two items, according to School of Aviation Medicine witnesses, were good reasons for stating that the costs incurred by G.E. were excessive, and they stated that it was their belief that the entire life support system could have been built by the School for $120 thousand.

LMSD stated that it believed that technical management control of the biomedical program by the General Electric Company was inadequate. This statement was based upon the inability of General Electric to meet the schedule and further was reflected by problems incurred in the life support system equipment. LMSD did believe the financial control of the program to be adequate.

2. Conclusions: Costs incurred by General Electric Company in the development of the life support system greatly exceeded G.E. original estimates. Because of an under-estimate of the technical task to be accomplished, greater costs were incurred than would have been the case if a better appreciation of the task to be performed had been realized from the beginning. Further, there was inadequate technical management control in the program because of the inability of G.E. to recognize in the beginning the magnitude and scope of the task to be performed.

D. Allegation D. "There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program."

1. Discussion: There is no doubt from the Board review

of records and testimony that USAF biomedical talent has been used liberally in the conduct of the life support system development. How *effectively* the talent was used has become the dominant question.

Life support system design efforts began in March 1958 with the re-orientation of the DISCOVERER program. From the beginning the AFBMD followed the ARDC policy of calling on Air Force biomedical talent, and established a working relationship with the School of Aviation Medicine, the AFMDC, and the WADC for support of this program. Later in the program, the 8 August 1958 ARDC directive, see Exhibit L, was issued, defining the responsibilities of the School of Aviation Medicine.

In spite of this attempt to formalize and emphasize the blue-suit contribution to the life support system development, it is clear from testimony before the Board that the actual use of military biomedical talent left much to be desired. Some major factors contributing to this situation are:

a. A lack of harmony among the organizations involved. Prime-subcontractor friction; the absence of a powerful, central directing agent; concern over jurisdictional prerogatives; personality conflicts and clashes; and other complex reasons contributed to a deteriorating working-level relationship among the principals, and inhibited the effective use of available military talent.

b. The over-riding consideration of meeting an iron-clad schedule always stimulates friction, and this development was no exception. In cases where design and testing methodologies diverged, it was frequently felt that precious time could not be diverted to building rapport among the contributing organizations. This led to a cyclical, self-generating problem situation where it became increasingly difficult for any of the participants to work efficiently and harmoniously.

c. Misunderstandings as to organizational responsibilities and management relationships, which affected the motivations of the people involved.

d. Serious underestimation of the technical task on the part of design and technical direction contractors, which further aggravated the already-complicated test and design environment.

e. Changing design criteria of the life support system because of newly discovered environmental conditions, coupled with a very tight development schedule, which encouraged the use of short-cut test plans and procedures, and often ignored the talent available for conducting these tests.

2. Conclusion: USAF personnel have been used liberally in the life support development; however, in many cases, and particularly in the case of School of Aviation Medicine personnel, the use has been inefficient, ineffective, and sometimes inconsiderate. One of the prime responsibilities of the AFBMD's life support system agent should be to re-establish rapport with the School of Aviation Medicine.

E. Allegation E. "Civilian corporations, specifically G.E., are using their particular positions in the biomedical program as a means of building their competence in the biomedical area." ~~CONFIDENTIAL~~

1. Discussion: During the second day of the [illegible]

SECURITY CLASSIFICATION (If any)

R+D 1c

# DISPOSITION FORM

| | |
|---|---|
| FILE NO. | SUBJECT<br>Biomedical Aspects of the Ballistic Missile Program |

TO WDTS FROM RDTHA DATE 6 June 58 COMMENT NO. 1

Lt Col Cain/kl/4145

1. Special Orders Number A-920, Department of the Air Force, 9 May 1958, assigned Brigadier General Donald D. Flickinger, Staff Surgeon and Director of Human Factors, Headquarters ARDC, to an additional duty, Special Assistant for Bio-Astronautics to the Deputy Commander for Ballistic Missiles, ARDC.

2. All research and development efforts, contemplating the use of biological payloads on board missiles or space vehicles, will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative.

3. To provide the Ballistic Missile Division with timely life sciences support in the coordination of procurement data, monitorship of contractor efforts, and supervision of inspection tests of components of life supporting and bio-performance measuring equipment, technically qualified life sciences personnel will be placed on TDY or will be assigned to the Ballistic Missile Division. These personnel will be authorized to render decisions regarding the adequacy of life supporting equipment and other technical problems concerned with viable payloads. This headquarters, ATTN: RDTH, will be informed of all decisions in this area. In addition, a monthly progress report on the development, fabrication, testing, and scheduling of the life sciences portion of the program will be provided.

4. A significant portion of the nation's life sciences capability in support of space operations is contained in certain Air Force medical and behavioral sciences research and development organizations. Certain of these agencies are hereby designated as points of contact for the weapons systems management organization and contractors concerned with development and fabrication of life supporting equipment and life sciences experiments. The designation of these units is for the primary purpose of assuring that the contractor has the latest information available for incorporation into his design, and secondly, to assure the fabricated unit meets the technical criteria as established by the Air Force. The bio-astronautical members of the Ballistic Missile Division will obtain over-all approval and coordination of the life sciences aspect of the project. But, in so doing, will consult freely and frequently with the designated units, assuring that liaison is being maintained with the prime contractor and subcontractors on the technical biomedical and bio-performance problems associated with the projects.

a. Aeromedical Laboratory (WADC)

(1) Determination of the biological adequacy of subassemblies, technical specifications for the internal life support environment, and the normal technical development program responsibilities of the laboratory for such environments.

1-6-149

EXHIBIT K

the Board was advised by School of Aviation Medicine witnesses that this allegation did not properly express the thought they had in mind. It was pointed out that the School does not object to the growth of biomedical competence; its real objection is to the exploitation of non-biomedical personnel in attempting to achieve such competence. An example would be the use of physicists and engineers, rather than physicians and physiologists, in designing the life support system.

2. Conclusion: In the light of this explanation, the Board determined that Allegation E was more properly considered as part of Allegations B and D, and gave it no further separate treatment.

F. Directed Consideration A. "You are enjoined to make recommendations regarding the management structure of the present biomedical program and any suggestions for future follow-on biomedical programs."

1. Discussion: The Board believes that the primary requirement for increasing the managerial effectiveness of the present biomedical program is the designation of a single project director. Once such an appointment has been made, the director, and he alone, should be charged with the responsibility for establishing clear, formal arrangements among all project participants, including test protocols, definite count-down procedures, the designation of single spokesmen for all agencies, and similar matters. The director should be charged specifically with the responsibility for maintaining strict discipline

among the participants, and should be enjoined to make a special effort toward re-establishing rapport between technical personnel of ~~the~~ AFBMD and the School of Aviation Medicine.

With regard to future biomedical programs, the Board recommends similar management actions which would prevent many of the problems encountered in the present program.

a. The Commander AFBMD should designate a project director at the inception of any future projects. The project director should be empowered to, and directed to, make all AFBMD decisions on the project.

b. All participating agencies should be required to designate single spokesmen who exercise the same control in their organizations as the project director does for the AFBMD.

c. Definite test protocols and count-down procedures should be established far in advance of the need date, and should be regarded as iron-clad operating procedures by all participants.

2. Conclusion and Specific Recommendation: Testimony before the Board shows the need for (a) making maximum use of Air Force biomedical know-how in developing the life support system and (b) eliminating jurisdictional and functional disagreements between the Director of DISCOVERER and the Director of Bioastronautics. The Board notes that between 80 and 90% of the work of the Bioastronautics Directorate is in support of the DISCOVERER project. Having considered these factors, the Board makes the specific recommendation that the following actions be taken concurrently:

a. That the Director of the Bioastronautics Directorate be designated immediately as the single AFBMD spokesman, i.e., Project Director, for the Mark II Life Support System.

b. That the Bioastronautics Directorate be transferred immediately to the Assistant Deputy Commander for Space Systems.

G. Directed Consideration B. "Specific recommendations as to the technical course of action to be followed for the present biomedical program shots within the DISCOVERER series are required."

1. Discussion and Conclusions: A significant gain to national prestige as well as an important scientific contribution will result from the recovery of a live specimen from a polar orbiting vehicle. Notwithstanding the fact that time is a most important concern in conserving the prestige of the occasion, certain limits must be imposed on firing dates. Specifically:

a. The biomedical life support system must demonstrate reproducible evidence that it can in fact support a live specimen for the total mission profile.

b. The recovery package design and technique must be adequately demonstrated, based upon actual recovery from orbit.

c. The competence of all participants must be demonstrated in count-down procedures compatible with established launch controller requirements.

## VI. GENERAL CONCLUSIONS

### A. Technical.

1. A life support system cannot be considered to have met its ground test until it has been completely bench checked and has successfully passed a complete laboratory count-down which simulates as closely as possible the problems of launching, orbiting, re-entry, and recovery, with thermal and noise profiles superimposed, and all integrated into the expected time sequence of a realistic mission. The DISCOVERER life support system has not met these criteria as yet, but under G.E.'s "new look" design and testing philosophy is definitely moving in this direction.

### B. Managerial.

1. "Crash", high-risk developments involving relatively unexplored technical areas should be:

a. Financed by requirements budgets rather than ceiling budgets.

b. Encouraged to sponsor competitive sub-system developments in any difficult technical areas.

c. Organized so that all contractors working in difficult technical areas are as accessible as possible to AFBMD direction and control.

d. Supported by in-residence AFBMD personnel at any contractor's plant where the development item is "pacing" or technically difficult.

None of these conditions have been applied to the life support system development.

2. A strong, single universally-recognized AFBMD leader should be appointed at the inception of all projects if the project is to succeed. This has not been done for the life support system development.

3. Test protocols must be developed far enough in advance of a test series to assure their acceptance as doctrine at the test itself. This has not been done for the life support system development.

4. Clear functional statements and designated single spokesmen are required for all agencies involved in a development or test if inefficiency, ineffectiveness, bickering, accusations, and counter-accusations are to be prevented. Specific designations of responsibility, by name, do not exist in the life support system development.

## VII. GENERAL RECOMMENDATIONS

### A. Technical.

1. That the AFBMD recognize the G.E. "new look" in design and testing as a proper, albeit long over-due, methodology for developing a flight-worthy life support system.

2. That the schedule for the flight of a life support system be based upon a clear demonstration, in ground tests, that the system can sustain a live specimen for the total mission profile and a clear demonstration, based upon actual recovery from orbit in flight test, that the recovery equipment meets its operating requirements.

### B. Managerial.

1. That a strong, single, clearly-designated leader be appointed at the inception of all development projects. This leader must be held responsible for organizing the participation of all agencies in a well-disciplined, harmonious manner.

2. In the specific case of the Mark II life support system development, this Project Leader should be the Director of the Bioastronautics Directorate; the Directorate itself should be transferred immediately to the Assistant Deputy Commander for Space Systems.

3. Comprehensive iron-clad test protocols and count-down procedures should be developed at once for the life support portion of the DISCOVERER program.

4. Clear functional statements and a list of officially-designated single spokesmen should be developed by the Project Director for all agencies participating in the life support system development.

5. A special effort should be made, under the leadership of the Project Director, to re-establish rapport between technical personnel of the AFBMD and the School of Aviation.

PAUL E. WORTHMAN, President
Colonel, USAF

JOHN E. PICKERING, Member
Colonel, USAF

JAMES S. SEAY, Member
Lt. Colonel, USAF

FRED BERNER, Member

WILLIAM H. WEAVER, Recorder
Major, USAF

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

SPECIAL ORDERS)
NUMBER. 20)

27 November 1959

Under the provisions of AFBMDIR 11-6, AFR 14-6, AFR 11-1, AFR 120-3, and at the written direction of Commander, Air Force Ballistic Missile Division, the following named individuals are appointed to an Investigating Board on an ad hoc basis, for the purpose of reviewing the management and technical status of the biomedical project currently associated with the DISCOVERER Program. Upon submission of the Board report and approval by the Commander, Air Force Ballistic Missile Division, the board is dissolved. In the absence of the President the senior member present at the meeting will act as President and in the absence of the Recorder, the junior present will perform the duties of the Recorder. The Recorder will notify the Director of Administrative Services when the Board is dissolved.

| | | |
|---|---|---|
| *COL LEO P. GEARY, 8037A | HQ USAF | President Voting |
| COL PAUL E. WORTHMAN, 7324A | HQ AFBMD | Member Voting (Alt. President) |
| *COL JOHN E. PICKERING, A0724350 | SCHOOL OF AVIATION MEDICINE | Member Voting |
| *LTCOL JAMES S. SEAY, 12319A | HQ AMC(BMC) | Member Voting |
| LTCOL RAYMOND E. ZELENKA, 12701A | HQ AFBMD | Member Voting |
| MAJ WILLIAM H. WEAVER, 14813A | HQ AFBMD | Member Voting (Recorder) |
| *DR. FRED BERNER | WRIGHT AIR DEVELOPMENT CENTER (BIOMED LAB) | Member Voting |

*With concurrence of respective Commander.

FOR THE COMMANDER:

OFFICIAL

E. L. JACKMAN
Lt Colonel, USAF
Dir of Administrative Services

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5 - WDC
5 - WDL
5 - AC (SAC MIKE)
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1 - WDAS

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

SPECIAL ORDERS)
NUMBER 31)

1 December 1959

1. Under provisions of AFR 60-18, MAJ IVAN H DETHMAN, 14258A, HQ AFBMD. Los Angeles, Calif is attached to Los Angeles Air Defense Sector, Norton AFB, Calif for the purpose of maintaining flying proficiency.

2. The verbal order of the Commander on 25 Nov 59, authorizing A/1C LARRY K WALKUP, AF13294151, 6592d USAF Dispensary, ARDC, Los Angeles, California, BAS at the rate of $2.57 per day effective 1600 hours, 25 Nov 59, under the provisions of paragraph 20101D, AFM 173-20, is confirmed. Exigencies of the service having been such as to preclude the issuance of competent written orders in advance.

3. Special Orders Number 20, this Hq, dated 27 Nov 59, relating to the establishment of an Investigating Board on an ad hoc basis for the purpose of reviewing the management and technical status of the biomedical project currently associated with the DISCOVERER Program, is amended to delete so much as pertains to COL LEO P GEARY, 8037A, HQ USAF, and is further amended so much as reads: "COL PAUL E WORTHMAN, 7324A, HQ AFBMD. Member Voting (Alt. President)" is amended to read: "COL PAUL E WORTHMAN, 7324A, HQ AFBMD, President Voting".

4. MAJ FRANK R DEAN, 33846A, (Expense Code 4591100), HQ AFBMD, ARDC, Los Angeles, California, will proceed on or about 2 Dec 59 to USAF Hospital, March AFB, California on TDY for approximately 1 day for the purpose of medical consultation; and upon completion will return to Hq Air Force Ballistic Missile Division, Los Angeles, California. TPA. This mode of transportation has been determined to be more advantageous to the Government. TDN. 57x3600 047-9624 P690 S594200 0212. Authority: Chapter 16, AFM 35-11.

FOR THE COMMANDER:

OFFICIAL

E. L. JACKMAN
Lt Colonel, USAF
Dir of Administrative Services

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5 - WDF
5 - WDC
5 - WDL
1 - WDAS
5 - AC (SAC MIKE)
5 - ATC
2 - IBMA
1 - BSED (AU)
5 - Commander
LA Air Defense Sector
Norton AFB, California

# LIST OF WITNESSES

| NAME | AFFILIATION | RANK | SERIAL NUMBER |
|---|---|---|---|
| John T. Hart | LMSD | | |
| Stanley A. Hall | LMSD | | |
| Harry A. Gorman | SAM | Colonel, USAF | 19007A |
| Robert T. Clark | SAM | Dr. | |
| E. A. Miller | G.E. | | |
| E. S. Miller | G.E. | | |
| A. A. Little | G.E. | | |
| Fred Parker | G.E. | | |
| Robert W. Anderson | G.E. | | |
| Robert W. Roy | AFBMD F.O. VAFB | Captain, USAF | 22332A |
| James W. Plummer | LMSD | | |
| Leonard C. Ransler | LMSD | | |
| Erwin R. Archibald | AFMDC | Captain, USAF | 25685A |
| Clarence L. Battle | AFBMD | Lt. Colonel, USAF | 6209A |
| Albert W. Johnson | AFBMD. | Captain, USAF | 22226A |
| Frederick C. E. Oder | AFBMD | Colonel, USAF | 7684A |
| Harry L. Evans | AFBMD | Colonel, USAF | 4619A |
| Edward L. Cole | AFBMD | Lt. Colonel, USAF | 6563A |

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

REPLY TO ATTN OF: WDG

SUBJECT: Investigating Committee

29 October 1959

TO: WDZ (Colonel Curtin)

1. For several months I have been concerned with the progress of the biomedical mission of the Discoverer series. In the past few weeks, several complaints have been relayed to me from various sources. Accordingly, I should like you to establish a board of officers to thoroughly investigate the allegations. These allegations are as follows:

a. The basic design of the biomedical recovery capsule is faulty and as presently configured will not support the biomedical mission of the Discoverer series.

b. Management of the biomedical test program by AFBMD, LMSD, and GE is grossly inadequate.

c. Biomedical program costs being incurred by GE are too high and are not being subjected to proper management control.

d. There has been inadequate utilization of available military talent within the USAF in the conduct of the biomedical program.

e. Civilian corporations, specifically GE, are using their particular positions in the biomedical program as a means of building their competence in the biomedical area.

2. In addition to determining the truth of these allegations, you are enjoined to make recommendations regarding the management structure of the present biomedical program and any suggestions for future follow-on biomedical programs. In addition, specific recommendations as to the technical course of action to be followed for the present biomedical program shots within the Discoverer series are required. The board of officers should be composed of personnel from Hq USAF, Hq ARDC, SAM, BMC, and AFBMD. The board should be constituted and convened at the earliest possible date with recommendations to be forwarded to me not later than 20 November 1959.

O J Ritland

O. J. RITLAND
Major General, USAF
Commander

Extract from Amendment #2 to Letter Contract AF 04(647)-181 dated 16 May 1959.

a. Item 3 of Exhibit is revised to read:

"Physical Recovery System in accordance with Exhibit B attached hereto and made a part hereof."

b. Subparagraph 6 of Exhibit B is revised to read:

"Develop a recoverable capsule to accommodate an aero-medical package for use with the Pioneer vehicle. The complete capsule shall be available for flight-test no later than 30 November 1958.

Exhibit 'D"

SECRET ~~CONFIDENTIAL~~

Extract from Contract AF 04(647-181) definitized 6 January 1959
Date Contract awarded: 25 January 1958

2.5.10.1.1.4 The Contractor shall be responsible for:

a. Ground and flight test data analysis and reduction.

b. The engineering evaluation of the overall reconnaissance system and provision of the results to the appropriate organization for use in future designs.

## 2.5.11 Biomedical Capsule (Subsystem L)

## 2.5.11.1 Item I - Research and Development

2.5.11.1.1 Biomedical Data. This data shall be obtained by the selection of suitable vertebrate specimens and environmental instrumentation, as permitted by the WS-117L payload weight limitations, with the primary objectives of demonstrating specimen survival and cosmic radiation effects.

2.5.11.1.2 The WS-117L design modification shall be accomplished as required to maintain the recovery capsule program current. The auxiliary power system shall be arranged to provide electrical power required by the capsule during the ascent and orbiting flight phases.

2.5.11.1.3 Recovery Capsule. The Contractor shall design as required by the conditions of re-entry and shall include suitable equipment for the survival of the biomedical specimen and for the recovery of cosmic radiation and biomedical environmental data. The capsule shall be equipped with beacon, dye marker, and strobe lamp equipment as considered feasible to facilitate the search and recovery operation.

2.5.11.1.3.1 The Contractor will develop and design the complete Biomedical Recovery Capsule including the necessary components, subassemblies, and retro-rocket system. Government technical agencies will provide available technical advice, biological specimen [illegible]formance, environmental requirements, biological specimen tests, and shall approve the environmental provisions of the capsule assembly.

DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS.
DOD DIR 5200.10

~~CONFIDENTIAL~~ SECRET

2.5.11.1.3.2 The BRC shall be designed, insofar as possible, to assure the launch, orbit, and recovery of the viable animal subjects and instrument subassemblies. Conditions shall be provided so that the animal subjects will have suffered no irreversible damage except that damage ascribable to prolonged weightlessness and cosmic radiation.

2.5.11.1.3.3 The Biomedical Recovery Capsule assembly shall consist of the following major assemblies:

a. Shell Assembly. A shell assembly shall be designed for assurance of the structural integrity under the stress conditions encountered during boost, orbit, and recovery, and shall provide the necessary design characteristics to ensure thermal heat balance during flight.

b. The capsule shall include a recovery package complete with radio beacons, strobe lights, radar chaff dispensers, dye markers, parachutes, and the auxiliary equipment necessary to ensure the maximum opportunity for location and recovery.

c. Environmental Controls. The environmental subassembly shall include the necessary nutrients, water, atmospheric conditions, temperature, and pressure to assure adequate life conditions for the selected viable specimen.

d. Capsule Internal Structure. The capsule internal structure shall be so designed that the acceleration forces of boost, re-entry, and impact will be within the tolerances of the viable specimen selected. This internal structure shall also provide for acceptable environmental temperature conditions.

e. Instrumentation. Instrumentation shall be provided to include a minimum of the following data:

1) Ascent and Orbit Interval
    - a) Capsule air temperature
    - b) Capsule air pressure
    - c) Oxygen pressure
    - d) Capsule humidity
    - e) Viability indication (desirable but not mandatory)
    - f) Camera coverage (desirable but not mandatory).

2) Re-entry Interval
    - a) Capsule air temperature
    - b) Acceleration in 3 orthogonal planes
    - c) Oxygen pressure
    - d) Capsule pressure
    - e) Noise level
    - f) Viability indication (desirable but not mandatory)
    - g) Camera coverage (desirable but not mandatory).

Adequate instrumentation for the recovery of data in accordance with the flight test objectives of paragraph 2.5.11.3.3 shall also be provided.

f. Retro-rocket Equipment. The capsule assembly shall include the necessary retro-rocket equipment for the initiation of re-entry.

g. Electrical Power. Adequate electrical power shall be included for the operation of internal capsule equipment.

2.5.11.1.4 Search and Recovery Operation. A program will be planned, developed, and coordinated to initiate the recovery of the re-entry capsule, with consideration being given to primary "air snatch" operations as well as water and land recovery plans. To ensure a communication system and arrange for the transmission of biomedical data by means of the telemetering system and for the initiation of the capsule re-entry and recovery phase through suitable command programmer arrangements, adequate coordination must be assured. Adequate coordination must also be assured to plan for tracking the package over a sufficient portion of the trajectory to permit recovery.

2.5.11.1.5 Environmental Performance Specifications. The purpose of this specification is to outline the environmental parameters necessary to support life in the BRC. The maximum or minimum values stated below cannot usually be regarded as optimum for homeostasis; therefore, when possible, optimum values will be presented. The Contractor will make every reasonable effort to achieve the optimum values during any phase of flight and will not exceed maxima or minima at any time after launch. A 14.7 psi pressure schedule is acceptable prior to launch, and, if used, will consist of approximately 730 mm Hg partial pressure oxygen, 10 mm Hg partial pressure water, 10 mm Hg partial pressure inert gas, 8 mm Hg partial pressure carbon dioxide and 3 mm Hg partial pressure other gases.

a. Total Pressure. The pressure of the enclosed environment will not be less than 5.0 psi (258 mm Hg) nor more than 10.10 psi (522 mm Hg). The optimum value is 5.0 psi unless contraindicated by engineering requirements.

b. Oxygen Partial Pressure. The partial pressure of oxygen will not be less than 150 mm Hg nor more than 300 mm Hg.

c. Carbon Dioxide Partial Pressure. The partial pressure of carbon dioxide will not exceed 8 mm Hg at any time. Any value less than this is optimal.

d. Water Partial Pressure. Partial pressure of water vapor may vary between 5 mm Hg and 10 mm Hg. 10 mm Hg is optimal.

e. Biologically Inert Gas Partial Pressure. The inert gas found in the enclosed environment may be either nitrogen or helium. Partial pressure of the gas used will not be more than approximately 190 mm Hg. The optimal value is 10 mm Hg.

f. Other Gases. Other gases present such as hydrogen sulfide, indoles, skatoles, etc. will not exceed 3 mm Hg.

g. Toxins. Endogenously produced toxins (other than biological) such as battery gas, lithium hydroxide dust, etc. will be excluded or filtered from the system. Other toxins which may be produced by exogenous phenomena in orbit, e.g., ozone, need not be controlled.

h. Temperature. The air temperature of the enclosed environment will be maintained between 55° and 85° F. The optimum temperature is 70° F. Temperature peaks during re-entry will not exceed 120° F for 5 minutes nor 100° F for 30 minutes. Wall temperatures of the bio-pack may rise to values higher than this for correspondingly briefer periods of time, but should be maintained at levels unlikely to produce tissue damage on contact.

i. Time. The environment described above will be maintained for at least 84 hours for Missions A B, C, and D and at least 132 hours for Mission E.

j. Acceleration. All accelerative forces imposed on the animals will lie under a curve described by the following time-dwell versus 'g' coordinates: 70 g's for .1 sec; 35 g's for 1 sec; 18 g's for 10 sec; 9.5 g's for 100 sec; 5 g's for 1000 sec.

2.5.11.1.6 Ground Support Equipment. Ground support equipment shall be designed for the preparation, checkout, and installation of the recovery capsule system.

2.5.11.1.7 Data Reduction. Machine analysis of telemetered data will be performed.

2.5.11.1.8 Test Plan. A test plan outlining the acceleration, vibration, noise, environmental simulation, and drop recovery tests to be performed on components, subassemblies, and full assemblies, will be submitted to the Government for approval. The test plan will also indicate the use of animals and Contractor available test facilities, and the desired use of the Government test facilities needed to implement the test program.

2.5.11.1.9 Prior Approval. Rough drawings, "first approximation" data, specifications, plans, informal presentations, etc. will be submitted to the Government for approval prior to purchase, fabrication, or assembly of components, subassemblies, and full assemblies.

2.5.11.2 Item II - Hardware

2.5.11.2.1 Biomedical subsystems shall be produced as further defined in this paragraph to satisfy the requirements of the program as enumerated in Section 1.0 of the Work Statement. Biomedical Recovery Capsule assemblies shall be fabricated with the necessary spare units and test articles to support a series of five flight experimental programs indicated in the following tabulation.

| SHOT | PURPOSE | ANIMAL | INFORMATION AND INSTRUMENTATION |
|---|---|---|---|
| A | Survival and Recovery | (4) Mice (4C-57) | Temperature, total pressure, oxygen bottle pressure, acceleration, noise level, humidity, viability, cosmic radiation |
| B | Survival and Recovery | (4) Mice (4C-57) | Same as A |
| C | Survival and Recovery | (1) Rhesus Monkey | Same as A plus psycho-operant task |
| D | Survival and Recovery | (1) Rhesus Monkey | Same as C |
| E | Survival and Recovery | (1) Rhesus Monkey | Same as C |

2.5.11.2.2 Ground support equipment, as described in Paragraph 2.5.11.1.6 shall be produced.

## 2.6 COORDINATION OF SUBSYSTEM A THROUGH H WITH SUBSYSTEM I, "DATA PROCESSING" SUBSYSTEM

In order to ensure optimum design and development of the complete WS-117L system and the proper meshing of applicable portions of Subsystems A through H with Subsystem I, the Data Processing Subsystem, LMSD and the Prime Contractor SS/I will collaborate to make arrangements for a sufficiently full and timely flow of information from each project to the other and from each set of subcontractors to the other, as their work affects the interfacial areas. They will jointly arrange orderly means to bring to light any divergencies between the two parts of the total program, to effect the best possible compromises as they are needed, and to refer to the Government Contracting Officers (LMSD to BMO and Prime Contractor SS/I to RADC) for decision on any questions that cannot be

### 2.2.2.6 Visual Surveillance Program

2.2.2.6.1 The Visual Surveillance Program consists of the development of a continuous surveillance system at ground resolutions equal to or better than that obtained with the Advanced Visual Reconnaissance Program.

### 2.2.2.7 Ferret Surveillance Program

2.2.2.7.1 The Ferret Surveillance Program consists of the development of a surveillance type ferret as well as a Quick Reaction Capability (QRC). It will be an integrated ferret system that provides the capability of varying the frequency bands and other signal parameters of interest by command through the ground-space communications link.

### 2.2.2.8 Biomedical Recoverable Capsule Program

2.2.2.8.1 The Biomedical Recoverable Capsule Program shall have the dual objectives of gathering biomedical data and establishing successful re-entry and recovery from orbit of selected living specimens.

### 2.2.3.12 Biomedical Capsule (Subsystem L)

2.2.3.12.1 The Biomedical Program consists of a satellite-borne capsule, suitable vertebrate specimens and equipment that will collect and transmit biomedical data by telemetering and ensure successful specimen survival after re-entry and recovery from orbit.

2.2.3.13 Personnel Subsystems. By definition, a personnel subsystem exists whenever any of the above subsystems, or the booster subsystem, requires the interaction of personnel. A properly designed personnel subsystem consists of the following components: (a) Human engineering to insure optimum man-machine compatibility. (b) Determination of the kinds and numbers of personnel required to operate and maintain the associated hardware subsystem. (c) Training and training equipment required to obtain suitably trained personnel. (d) Appropriate personnel supports in the form of technical manuals and other job aids.

To distinguish between personnel subsystems developed for Contractor personnel in contrast to Air Force personnel, the terms "Contractor Personnel Subsystems" and "Air Force Personnel Subsystems" are used.

SECRET

OFFICE OF THE SECRETARY OF DEFENSE

WASHINGTON 25, D. C.

28 February 1958

**MEMORANDUM FOR: SECRETARY OF THE AIR FORCE**

**SUBJECT: RECONNAISSANCE SATELLITES AND MANNED SPACE EXPLORATION**

1. Reference is made to the Air Force Proposal for Accelerating military reconnaissance satellites and outer space vehicle projects discussed in your memorandum dated 12 November 1957, and your memorandum of 1 February 1958 requesting that continuation of the Air Force military reconnaissance project be clarified.

2. I have reviewed your proposal in consultation with the Director of Guided Missiles, The Special Assistant to the President for Science and Technology, and the Director of Central Intelligence. In our review we have been guided by the following general policy considerations:

a. The Department of Defense must be alert to avoid within and between the services any unnecessary duplication of military and scientific space projects even though some degree of risk is thereby involved, in order that funds and other resources may be available for the large variety of absolutely essential programs.

b. The scientific and engineering capabilities of each of the military departments must be used with maximum effectiveness and efficiency. No single military department should be overloaded with too many high priority, crash programs.

c. In addition to its missile programs, the Air Force is responsible for the 117L Advanced Reconnaissance System and has a recognized long term development responsibility for manned space flight capability with the primary objective of accomplishing satellite flight as soon as technology permits. It is important to achieve an adequate concentration of effort and energy within the Air Force on these programs with a minimum diversion of attention and of resources to lower priority projects.

3. On the basis of the foregoing general considerations as well as of more specific technical judgments, I have arrived at the following conclusions on the points raised in the two above referenced memoranda.

a. The ATLAS 117L project should be accelerated and carried forward under the highest national priority in order to attain an initial operational capability at the earliest possible date.

b. The proposed interim reconnaissance system made up of a Thor booster combined with a second stage which carries a lightweight payload in the form of a recoverable capsule, duplicates rather than complements the ATLAS 117L capability. The interim system would give only a small improvement in time over the ATLAS 117L. Moreover, the successful and continuous operation of a recoverable reconnaissance system, with the attendant requirement for search, appears infeasible from a practical and useable military point of view. Accordingly, the development of the interim system should not be pursued.

c. In order to attain early flights of the Lockheed vehicle to be employed as the second stage in the 117L system, it may be desirable for the Air Force to plan for test firings of this vehicle utilizing a THOR booster, since an adequate number of these less expensive boosters can be made available for this purpose sooner than the ATLAS booster will be available.

d. I understand that a THOR booster with a suitable second stage vehicle may be the most promptly and readily available device for experimental flights with laboratory animals. The development of such hardware is authorized, including provision for the recovery of the animals, in furtherance of the objective of manned satellite flight.

S/ Roy Johnson

DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY

HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Andrews Air Force Base
Washington 25, D. C.

File
perry

ADDRESS REPLY TO
COMMANDER, ARDC ATTN
RDZGW

22 MAY 1958

SUBJECT: (U) Support of Bioastronautics Program

TO: Commander
Air Force Ballistic Missile Division (ARDC)
P. O. Box 262
Inglewood, California

1. In partial implementation of the authority granted under paragraph 3d, Memorandum for the Secretary of the Air Force from the Director, Advanced Research Projects Agency, OSD, 28 February 1958, subject, "Reconnaissance Satellites and Manned Space Exploration," and in the interests of an expeditious start to the investigation of the biomedical aspects of manned spaced flight, it is desired that steps be taken to include bioastronautics support as a secondary objective in from three to five of the planned THOR-boosted WS-117L flights which are scheduled to begin in November 1958. ~~(SECRET)~~

2. To provide you with an in-house primary biomedical technical competence and authority, Brig. General Don Flickinger is now assigned the additional duty of Special Assistant to the Commander, AFBMD for bioastronautics and as such will be responsible for the direction and coordination of all the biomedical aspects of projects assigned to your organization. In addition, two biomedical project officers are being permanently assigned to your Space Systems Division to provide necessary technical competence on a continuing basis. It is expected, of course, that you will also make use of other competent individuals and groups in the Air Research and Development Command and elsewhere in an advisory role, as needed. ~~(SECRET)~~

3. In order that this biomedical work will interfere as little as possible with WS-117L development and testing, control of all aspects of this work will rest with your organization. It is further desired that in the interest of conserving time and resources, the AFBMD will, insofar as possible provide support to this work within the existing WS-117L contractual structure. ~~(SECRET)~~

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~~CONFIDENTIAL~~

WD-58-03427

EXHIBIT F

B/L to AFBMD, Subject, "(U) Support of Bioastronautics Program"

4. I am directing the necessary action to provide an additional budget authorization and allotment of $449,000 of FY 1958 P-600 funds to your organization to cover the biomedical aspects of the efforts already underway in the WS-117L Program. In addition, $100,000 has been transferred from the School of Aviation Medicines' resources (line 780A-7851) to your organization. (UNCLASSIFIED)

5. It will be necessary for you to take action to insure that ARPA programs additional FY 1959 funds of all types (P-600 R&D; P-600 Operation and Management; and non-P-600 funds) to cover the cost of continued effort in the WS-117L Biomedical Recoverable Capsule activity. The FY 1959 P-600 R&D funds to be programmed for this purpose total $6 million and will cover the cost of development, design and fabrication of the recoverable capsule, animal container, instrumentation and telemetry, associated recovery equipment, conduct of the recovery operation, etc. The FY 1959 requirements for P-600 Operation and Management funds and non-P-600 funds have not been established as yet. ~~(SECRET)~~

S. E. Anderson

S. E. ANDERSON
Lieutenant General, USAF
Commander

~~CONFIDENTIAL~~

Missile Systems Division * Sunnyvale, California

6 May 1958

In Reply Refer to:
LMSD/56989
WS117L/32

Subject: Contract No. AF 04(647)-181
Biosatellite Flight Program Plan

To: Commander
Air Force Ballistic Missiles Division
Hdqtrs., Air Research and Development Command
Attn: Col. F.C.E. Oder (WDTSR)
P. O. Box 262
Inglewood, California

Reference: (A) AFBMD TWX to LMSD, dtd. 11 March 1958, (LMSD/37894)

(B) Letter Contract AF 04(647)-181, dtd. 25 January 1958, (LMSD/37125)

1. The TWX of Ref. (1) from AFBMD to LMSD redirected the efforts of the 117L program under the letter contract Ref. (2) to include biosatellite flights as secondary objectives of the IIA (Thor Boosted) portion of the program. This redirection has eliminated the requirement for development of a system suitable to the recovery of photographic film from an orbiting vehicle and replaced it with the need for developing a modified recovery technique appropriate to the support of the aeromedical explorations to be conducted in consonance with the new secondary objectives of the program.

2. Prior to the redirection of Ref. (1) a division of responsibility between prime and subcontractor had been established and a work plan approved by the USAF for accomplishment of the film recovery program. The change in the recovery aspect of the program has required a redetermination of responsibilities for the prime and subcontractors in accomplishing the redirected work and has been defined by LMSD, based on discussion with members of the USAF, as follows: LMSD will assume over-all system responsibility for all biosatellite flights incorporated into the flight program. As weapon system contractor LMSD will determine the general specifications for the subsystem, the general manner in which the subsystem will be developed, the integration of the subsystem into the program, and will select for approval of USAF subcontractors to be used. Supporting studies and developmental investigations will be made as necessary to establish technical validity of design and feasibility of intended flights. All phases of the program attendant to the operational recovery are considered the responsibility of LMSD. It is intended to augment the capability of LMSD by the use of subcon-

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EXHIBIT-G

tractors so as to permit the most expeditious achievement of the program. Subcontractor efforts will be:

- (a) Design and construction of the re-entry shell.
- (b) Design and construction of the biosatellite sealed capsule including all necessary environment control and life-support components.
- (c) Experimental animals and training as approved by the Air Force.
- (d) Biomedical data sensors, processors, and on-board recorders as approved by the Air Force.
- (e) Design and construction of recovery devices on or in the biomedical capsule.
- (f) Test program for proving satisfactory performance of the biomedical capsule.
- (g) Design and construction of ground support trailers for biomedical capsule.

3. The weapon system contractor recognizes General Electric's paramount position in this field and concurs with the Air Force direction that General Electric be made sole source subcontractor to assist in accomplishment of tasks (a) through (f) listed above. A separate subcontract will be established for accomplishment of task (g).

4. It has been requested by the USAF (meeting at LMSD between representatives of AFBMD, HDRME, and LMSD) that the aeromedical payload be included in the 2nd flight of the IIA (Thor Booster) program scheduled for December 58. It is recommended that the incorporation of this AM payload be withheld until the 3rd flight scheduled for January 59. It is further recommended that the total number of biosatellite flights be five with a possible sixth with a flight position as shown by the following schedule.

This recommendation is based on the indication by USAF that Thor boosted flights in addition to the ten presently programmed will be required to complete the USAF objectives and therefore would permit later scheduling of biosatellite flights. This will permit better utilization of the early flights in the accomplishment of the program's primary objectives, namely "proof of the basic 117L vehicle". The schedule proposed would be as follows:

| Flight | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Month | 11/58 | 12/58 | 1/59 | 2/59 | 3/59 | 4/59 | 5/59 | 6/59 | 7/59 | 8/59 |
| Obj. | 117L | 117L | AM | 117L | 117L | AM or 117L | AM | AM | AM | AM |
| Engine Fuel | (- - - - -JP4- - - - - -) | | | | | (- - - - - - - -UDMH- - - - - - - - - -) | | | | |

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5. On the basis of previous discussions with members of AFBMD and on the assumption of your concurrence, LMSD is proceeding to establish subcontracts in accord with the definition of responsibilities as stated above. Early approva of the schedule shown herein is requested to permit its immediate incorporation into the program.

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

J. H. Carter, Manager
XA Weapon System Branch

JHC:FWO'G:sg

cc: Deputy Air Force Plant Representative
Sunnyvale, California

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COORDINATION SHEET

OFFICE OF ORIGIN WILL ENTER OFFICE SYMBOLS IN THE "TO" BLOCKS IN ORDER OF DESIRED COORDINATION

PERSON COORDINATING WILL ENTER NAME AND DATE IN APPROPRIATE BLOCK

|  |  |
|---|---|
| TO: | MCPTA |
| NAME: | CKV |
| DATE: | Aug 58 |
| TO: | WDSRF |
| NAME: | [illegible] |
| DATE: | 28 Aug 58 |
| NAME: | 27 Aug |

WDDSR

SEP 4 1958

SUBJECT: Contract 04(644)-101, Internal Air Force Responsibilities Concerning Biosatellite Programs.

TO: Lockheed Aircraft Corporation
Missile Systems Division
ATTN: Mr. J. E. Carter
3251 Hanover Street
Palo Alto, California

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1. The following Air Force internal agreements concerning the Biosatellite Program technical responsibilities to be assigned to the School of Aviation Medicine and the Bioastronautics Division are furnished for your information and guidance.

a. The Bioastronautics Division (BAD) has been given managerial responsibility for all animal biosatellite programs and will act as technical director to the contractor on biomedical aspects.

b. Biomedical consultation will be provided to the maximum by in-Air Force consultants. Use of non-Air Force biomedical consultation will be held to an absolute minimum and use of such consultants, when necessary, will be approved by Air Force.

c. The School of Aviation Medicine will provide to the contractor, via the Bioastronautics Division, environmental standards, biomedical objectives and limits, experimental design, data to be collected and technical approaches to be used. However, if these criteria cannot be provided in time to meet the contractor's deadlines, BAD will initiate action to secure such criteria from other available sources.

d. The School of Aviation Medicine will consult on biomedical test programs and evaluate biomedical test results.

e. The School of Aviation Medicine will provide continuous biophysical and biomedical technical standards, liaison and consultation to the contractor as these are related to the biomedical success of the experiment. Any changes resulting from this liaison which would affect cost or time expended by contractor must receive prior approval by BAD through BMD/BMO.

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PERSON COORDINATING WILL ENTER NAME AND DATE IN APPROPRIATE BLOCK

WDTSL/BAD
BW Kim 1Ct
Sept 58

f. Direct contact is authorized between BAD and contractor; information copies will be provided to BAD and [illegible].

2. The above does not change the fact that the WS 117L Project Office WDTSR - [illegible] has responsibility for non-medical aspects of Subsystem [illegible] and is Lockheed's official contact point with the Air Force.

SIGNED
FREDERIC C. E. ODER
Colonel, USAF
Director for WS 117L

Copies furnished:
AFPR, LMSD
ATTN: Mr. J. McLachlin
Sunnyvale, California

WDTSL/BAD

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| DICTATOR: Capt Johnson | PHONE NO.: 2594 | DATE OF DISPOSITION |

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[redacted]

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CONF[illegible]TIAL

| ATE | FACILITY | DURATION | COMPONENT FAILURE | USE | REMARKS |
|---|---|---|---|---|---|
| /1/59 | BEMCO | 5 1/2 Hrs. | $O_2$ Regulator | 96 | Component Failure - Test aborted to save animal |
| /4/59 | BEMCO | 30 Hrs. | Air Con. | 96 | Animal died - A/C did not function - R. H. & Temp too high<br>G. E. (After Failure) stated A/C would not functio vertical position. No mention of this limitation by G. E. Rep. at time of test. |
| /4/59 | HADC | 23 Hrs. | L/C Leaks & Air Cond. | 133 | Animal died - A/C did not function even tho unit was horizontal - Cooler external test line froze L/C Temp too high |
| 16/59 | SAM | 27 Hrs | $O_2$ Reg. | 133 | $O_2$ Reg. bypassed after failure, no alt. or temp. simulation - animal survived |
| 18/59 | HADC | 28 Hrs. | None | 133 | Sled Run - no failures |
| 22/59 | HADC | 36 Hrs. | None | 133 | Alt. Chamber - no failures |
| 30/59 | HADC | 24 Hrs. | Air Cond.<br>L/C Leaks | 133 | Animal died - L/C temp. too high & $CO_2$ too high - Fan Opn on 18v not adequate |
| 3/59 | WPAFB | 24 Hrs. | None | 133 | Centrifuge Test - no failures |

## SUMMARY OF LIFE CELL SYSTEM TESTS WITH ANIMAL (CONT'D)

| E | FACILITY | DURATION | COMPONENT FAILURE | U/E | REMARKS |
|---|---|---|---|---|---|
| 0/59 | HADC | 22 Hrs. | 'O' Ring &<br>Tygon Tubing | 152 | Test aborted to save animal - Alt. Chamber - Lost L/C Press. - 'O' Ring & Tygon Tubing leaks |
| 15/59 | HADC | 19 Hrs. | B/B Valve Leak | 152 | Animal Died - Alt. Chamber - nitrogen build up due to failure to purge after air valve leak repair |
| 24/59 | HADC | 25 Hrs. | None | 133 | Sled Run - No Failures |
| 1/59 | VAFB | 21 Hrs. | Pyroswitch<br>$O_2$ Reg. | 152 | Alt. Chamber - Test aborted to save animal - Comp. Press low - Pyroswitch blew on Instln. Partially switching over to recovery mode |
| 25/59 | BEMCO | 21 Hrs. | Air Cond.<br>Sintered Plates | 15 | Alt. Chamber - Test aborted to save animal - $CO_2$ & R. E. very high - EKG did not read out |

(2) Ground support equipment and other unique requireme
logical specimens.

(3) Behavior conditioning and performance measuring req

b. USAF School of Aviation Medicine

Recommendations concerning instrumentation of the biolog

c. Aeromedical Field Laboratory (AFMDC)

Procurement, physical conditioning, maintenance, surfac
animals, and post-mission biological studies.

5. Previous instructions in conflict with the above can be cor
seded and no longer applicable to the biomedical program.

John R. V. Di

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander

5 Incls
1. Cy ltr to WADC, subj as above
2. Cy ltr to AFMDC subj as above
3. Cy ltr to AFCRC subj as above
4. Cy ltr to Air Univ subj as above
5. Cy ltr to AFOSR subj: Announcement of Desig & Org of Off Sp Asst for Bio-Astr to D/C for Ballistic Missiles, ARDC

HEADQUARTERS
AIR RESEARCH & DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
ANDREWS AIR FORCE BASE
WASHINGTON 25, D. C.

RDTHA 6 JUN 1958

SUBJECT: Biomedical Aspects of the Ballistic Missile Program

TO: Commander
Air University
Maxwell Air Force Base, Alabama

1. Special Orders Number A-920, Department of the Air Force, 9 May 1958, assigned Brigadier General Donald D. Flickinger, Staff Surgeon and Director of Human Factors, Headquarters ARDC, as an additional duty, Special Assistant for Bio-Astronautics to the Deputy Commander for Ballistic Missiles, ARDC.

2. All research and development efforts, contemplating the use of biological payloads on board missiles or space vehicles, will obtain the coordination and approval of the Special Assistant for Bio-Astronautics or his designated representative.

3. To provide the Ballistic Missile Division with timely life sciences support in the coordination of procurement data, monitorship of contractor efforts, and supervision of inspection tests of components of life supporting and bio-performance measuring equipment, technically qualified life sciences personnel will be placed on TDY or will be assigned to the Ballistic Missile Division. These personnel will be authorized to render decisions regarding the adequacy of life supporting equipment and other technical problems concerned with viable payloads. This headquarters, ATTN: RDTH, will be informed of all decisions in this area. In addition, a monthly progress report on the development, fabrication, testing, and scheduling of the life sciences portion of the program will be provided.

4. A significant portion of the nation's life sciences capability in support of space operations is contained in certain Air Force medical and behavioral sciences research and development organizations. Certain of these agencies are hereby designated as points of contact for the weapons systems management organization and contractors concerned with development and fabrication of life supporting equipment and life sciences experiments. The designation of these units is for the primary purpose of assuring that the contractor has the latest information available for incorporation into his design, and secondly, to assure the fabricated unit meets the technical criteria as established by the Air Force. The bio-astronautical members of the Ballistic Missile Division will obtain

over-all approval and coordination of the life sciences aspect of the project. But, in so doing, will consult freely and frequently with the designated units, assuring that liaison is being maintained with the prime contractor and subcontractors on the technical biomedical and bio-performance problems associated with the projects.

a. Aeromedical Laboratory (WADC)

(1) Determination of the biological adequacy of sub-assemblies, technical specifications for the internal life support environment, and the normal technical development program responsibilities of the laboratory for such environments.

(2) Ground support equipment and other unique requirements for biological specimens.

(3) Behavior conditioning and performance measuring requirements.

b. USAF School of Aviation Medicine

Recommendations concerning instrumentation of the biological subjects.

c. Aeromedical Field Laboratory (AFMDC)

Procurement, physical conditioning, maintenance, surface recovery of animals, and post-mission biological studies.

5. Previous instructions in conflict with this letter can be considered superseded and no longer applicable to the biomedical program.

6. Your concurrence with the provisions of paragraph 4, above, is requested.

FOR THE COMMANDER:

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander/R&D

1 Incl
Cy ltr to AFOSR
fr ARDC RDTHA

HEADQUARTERS
AIR RESEARCH & DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
ANDR [illegible] SE

RDTHA 6 JUN 1958

SUBJECT: Announcement of Designation and Organization of Office of Special Assistant for Bio-Astronautics to Deputy Commander for Ballistic Missiles, ARDC

TO: Commander
Air Force Office of Scientific Research
Washington 25, D. C.

1. Reference is made to Paragraph II, General Order Number 18, this headquarters, dated 22 May 1958, subject as above.

2. The Special Assistant for Bio-Astronautics, Ballistic Missiles Division, or his designated representative, will assume final technical coordination responsibility for all biological payloads placed on board ballistic missiles and space vehicles. In order that all bio-medical and behavioral science experiments and tests be known and appropriately coordinated and integrated with the Ballistic Missiles Program, it is requested that any research projects under the cognizance of your office, such as "Piggy Back," contemplating biological payloads be coordinated with the above office.

FOR THE COMMANDER:

JOHN R. V. DICKSON
Colonel, USAF
Asst Deputy Commander/R&D

[illegible]

HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Andrews Air Force Base
Washington 25, D. C.

ADDRESS REPLY TO
COMMANDER, ARDC, ATTN
RDTH

12 August 1958

SUBJECT: Responsibilities of School of Aviation Medicine in the ARDC Biosatellite Program, Subsystem L WS-117L

TO: Commander
Air University
Maxwell Air Force Base
Alabama

1. Pursuant to the directive of the Commander, Air Research and Development Command that all USAF biomedical resources be used in support of subject program, agreements have been reached between representatives of Headquarters Air Research and Development Command, Headquarters United States Air Force, Air University (Headquarters School of Aviation Medicine), Air Force Missile Development Center, and Wright Air Development Center, concerning technical responsibilities to be assigned to the School of Aviation Medicine.

2. As the result of the meeting referenced in paragraph 1, the inclosed statement of policy is hereby published as Supplement No. 1 to the letter from this headquarters, RDTHA, dated 6 June 1958, subject: Biomedical Aspects of the Ballistic Missile Program. Provisions of paragraph 4, referenced letter, in conflict with policy letter for subsystem L, will be disregarded.

FOR THE COMMANDER:

[illegible] J. WASSELL
[illegible]
[illegible]
[illegible]

1 Incl
Supplement No. 1, Hq ARDC
Letter, 6 Jun 1958, subj:
Biomed Aspects of Ballistic
Missile Program, 8 Aug 1958
(S)

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COPY

8 August 1958

SUPPLEMENT NO. 1 TO HQ AIR RESEARCH AND DEVELOPMENT COMMAND LETTER RDTHA, DATED 6 JUNE 1958, SUBJECT: BIOMEDICAL ASPECTS OF THE BALLISTIC MISSILE PROGRAM

1. Policy:

1.1 The United States Air Force is responsible for establishment of biomedical criteria for subsystem L capsules and specimens. The managerial responsibility for all animal biosatellite programs rests within the Bioastronautics Division (BAD), Air Force Ballistic Missile Division, Hq ARDC. The United States Air Force will specify environmental standards, biomedical objectives and limits, experimental design, data to be collected and technical approaches to be used.

1.2 Biomedical consultation will be provided to the maximum by in-Air Force consultants. Use of non-Air Force biomedical consultation will be held to an absolute minimum and use of such consultants, when necessary, will be approved by Air Force.

1.3 Air Force will act as technical director to the contractor on biomedical aspects.

2. Function:

2.1 The School of Aviation Medicine will provide to the contractor, via the Bioastronautics Division, criteria noted in paragraph 1.1, above.

2.2 The School of Aviation Medicine will consult on biomedical test programs and evaluate biomedical test results.

2.3 The School of Aviation Medicine will provide continuous biophysical and biomedical technical standards, liaison and consultation to the contractor as these are related to the biomedical success of the experiment. Any changes resulting from this liaison which would affect cost or time expended by contractor must receive prior approval by BAD.

2.4 All other decisions relative to test responsibility and conduct engineering requirements, scheduling, time and costing functions and general welfare of the program will remain with BAD or their properly designated representatives, and BAD decisions are final.

2.5 Whereas contractor costs will be supported by AFBMD (Hq ARDC), those costs and manpower requirements such as TDY, materials, transportation, labor and parts, incurred by the School of Aviation Medicine in the implementation of this policy will be borne by the School of Aviation Medicine, Air University.

C8-61,173

2.6 This policy becomes effective immediately. If the requirement for criteria referred to in paragraph 2.1 cannot be provided in time to meet contractors' deadlines, BAD will initiate action to secure such criteria from other available sources.

2.7 Direct contact is authorized between SAM and contractor; information copies will be provided to BAD.

DON FLICKINGER
Brigadier General, USAF (MC)
Director of Life Sciences

# FUNCTIONAL STATEMENT

DIRECTORATE, DISCOVERER SATELLITE SYSTEM (WDZSD), OFFICE OF THE ASSISTANT DEPUTY COMMANDER, SPACE SYSTEMS

1. Responsible to the Assistant Deputy Commander, Space Systems, for the integration of all research, development, and test aspects of the Discoverer Satellite System. Responsible for the determination of detailed performance specifications, pertinent physical characteristics, and essential functional criteria necessary to meet developmental or operational requirements. Monitors and/or co-ordinates the actions of all other participating AFBMD agencies in the preparation of detailed preliminary planning data, the production of development plans, and the formulation of work statements essential to the integration of all elements of the Discoverer Satellite System, to respond to specific Department of Defense and Air Force directives and requirements pertaining to the Discoverer System. Develops and maintains a closely co-ordinated time schedule for all directorate activity to insure that orderly progress in the system is maintained, and to permit the most effective expenditure of resources by identifying those areas which require timely attention. Evaluates contractor proposals as appropriate. Prepares and forwards reports as required. Directs and co-ordinates all AFBMD and contractor activities as appropriate for and pertaining to the development and test of the Discoverer System to insure the orderly and timely achievement of an operationally suitable and reliable system.

2. Co-ordinates the actions of all agencies participating in and supporting the development and test of the Discoverer System, including the AFBMD, ARDC Centers, other AF Command, U. S. Navy, and U. S. Army.

EXHIBIT M

# COORDINATION SHEET

| | | |
|---|---|---|
| TYPIST INITIALS<br>aem<br>26 Oct 59 | PERMANENT | |
| | TEMPORARY | |

WDZS/Col Oder/1522

Management of DISCOVERER Biomedical Program

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1. There have been a series of memoranda from various sources on the above subject.

2. The disagreement (as to whether or not a certain test was needed) arose, I believe, largely because of misunderstanding and with those directly concerned widely scattered about the country at the time the matter came up.

3. Generally speaking, in the subject program WDZPB serves as a sub-system manager supporting WDZSD. The arrangement has worked fairly well until the item cited in par 2 arose, and will, I believe continue to be effective.

4. While this current problem has been resolved, I must as a matter of policy support the view that the Director, DISCOVERER Satellite System is basically responsible for the quality of all aspects of the DISCOVERER Program and, accordingly, must have the authority which is required to meet the responsibility assigned to him.

SIGNED

| | |
|---|---|
| FREDERIC C. E. ODER | Copy to: |
| Colonel, USAF | WDZSD |
| Assistant Deputy Commander | WDZPB |
| Space Systems | WDZA |

EXHIBIT N

| | | | | | |
|---|---|---|---|---|---|
| NATOR COORDINATION | | | | | |
| | | | | | |

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VERBATIM TESTIMONY TO BE provided

~~SECRET~~

[redacted]

[redacted]

SEE DOCUMENT NO 167
for original

## APPENDIX B

This Launch Data Digest was Appendix D of several Lockheed Aircraft Corporation reports, but they reflect corrections made by Space and Missile Systems Organization's Historian, and the addition of information on the two last launches.

CLASSIFICATION OF THIS DOCUMENT
WILL BE DOWN GRADED TO Uncl
UPON REMOVAL OF ENCLOSURES.

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# APPENDIX D LAUNCH DATA DIGEST

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES DESCRIPTION | FLIGHT DESCRIPTION | EJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| System Test Report | 1019/160 | 4 | 1-21-59 | No | Simulated capsule | | Malfunction during countdown caused ullage rockets, retro-rockets, separation bolts, and horizon scanner fairing to fire when hydraulic motor was turned on. Design problem. Launch was aborted. | |
| 1<br>[illegible] | 1022/163 | 4 | 2-28-59<br>1349:16<br>PST | Probable (not confirmed) | Simulated capsule (recovery not programmed) | Hydraulic motor circuit separated from pyrotechnics circuit. | Injection angle - 1.7 deg. partially attributable to erratic hydraulic control at engine ignition. No telemetry or radar orbital contacts made. Questionable radio and radar contacts reported. | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>[illegible]<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 2<br>[illegible] | 1018/170 | 4 | 4-13-59<br>1318:42<br>PST | Yes | [illegible]. No | [illegible] incorporated. Horizon scanner active during engine burning phase, and gains altered to tighten control system. | Premature S-01 engine shutdown by command - cause unknown, but believed resulting from a main power relay malfunction. Orbit achieved, but inadvertent [illegible] reset command caused loss of recovery timing. Capsule ejected with re-entry over Spitsbergen. | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: 90 deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 3<br>[illegible] | [illegible] | 4 | ~~[illegible]~~ 6-3-59<br>1309:21<br>PST | No | [illegible] + (live payload) | Fairchild Timer incorporated. | Premature S-01 engine shutdown from either propellant interruption or exhaustion prevented vehicle reaching orbital velocity. Indicated cause - venturing or sloshing of oxidizer within tank. | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps |
| 4<br>[illegible] | 1023/179 | 5 | 6-25-59<br>[illegible]<br>PST | No | Advanced engineering test (AET) | None. | [illegible] | Azimuth: 177.3 deg (175 deg nom)<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps |
| 5<br>[illegible] | [illegible] | 4 | 8-13-59<br>[illegible]<br>PST | Yes | AET. No | Vehicle and payload weight reduced. [illegible] removed. [illegible] installed. Propellant capacity increased. [illegible] increased to yield elliptical orbit and longer period. | Burnout due to propellant exhaustion. High propellant utilization. Capsule ejected but not recovered. Recovery sequence believed not accomplished [illegible]. Capsule in orbit. | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 6<br>[illegible] | [illegible] | 5 | 8-19-59<br>[illegible]<br>PST | Yes | AET. No | Paint removed from nose cap area to improve capsule thermal characteristics. Weight further reduced by 13 lbs. | Integrator output low. Burnout resulted from propellant exhaustion. [illegible] Capsule ejected but not recovered. Recovery sequence again believed not accomplished. | Azimuth: [illegible] deg (170 deg nom)<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 7<br>[illegible] | [illegible] | 4 | 11-7-59<br>[illegible]<br>PST | Yes | AET. No. | [illegible] | [illegible] | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 8<br>[illegible] | [illegible] | 5 | 11-20-59<br>[illegible]<br>PST | Yes | AET. No. | [illegible] | [illegible] | Azimuth: [illegible] deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 9<br>[illegible] | [illegible] | 4 | 2-4-60<br>[illegible]<br>PST | No | AET. | [illegible]<br>a. [illegible]<br>b. [illegible]<br>c. [illegible] | [illegible] | Azimuth: 173 deg |
| 10<br>[illegible] | [illegible] | 5 | 2-19-60<br>[illegible]<br>PST | No | AET. | [illegible] | [illegible] | Azimuth: [illegible] deg ([illegible] deg intended) |

[illegible]

[illegible]

# APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 11<br>445934-55 | 1055/234 | 5 | 4-15-60<br>1230:37<br>PST | Yes | AEF. No | Similar to FTV-1052 | Liftoff and SLV-2 boost normal. S-01 engine cutoff premature due to error in calibration of command-[illegible] integrator scale factor. The resulting approximately 1 min shorter than planned period did not affect recovery. Horizon-scanner transients during orbit. Failure to recover capsule attributed to spin deficiency. | Azimuth: 172 deg<br>Altitude: 140.7 nm<br>Velocity: 26,065 fps<br>Inclination: 80.37 deg<br>Eccentricity: 0.052<br>Period: 92 min<br>Perigee: 106.0 nm<br>Apogee: 379.3 nm |
| 12<br>445934-63 | 1053/160 | 5 | 6-29-60<br>1500:44<br>PDT | No | Diagnostic. No | Similar to FTV-1052 | Orbital injection not achieved due to an erratic horizon-scanner output. As a result, negative flight path angle caused the S-01 to re-enter the atmosphere. SLV-2 boost somewhat low in velocity and altitude. From 130 to 142 sec, 10-cps SLV-2 oscillations occurred. A camera on the S-01 after burnout indicated blocking of one oxidizer vent nullifier outlet. | Azimuth: 171.7 deg<br>Altitude(nom)/127.7 nm<br>Altitude(HD): 161.7 nm<br>Injection Angle: -7 deg |
| 13<br>445936-57 | 1057/231 | 5 | 8-10-60<br>1337:54<br>PDT | Yes | Diagnostic. The first capsule recovery. Recovery made by helicopter at sea. | Vehicle weight reduced for heavier payload. AEF equipment, AFL beacon, and optical tracking lights removed. Horizon scanner modified to reduce transient susceptibility. Gas jet system replaced spin rockets on payload. | Successful liftoff achieved on first countdown. Boost altitude high but within tolerance. SLV-2 pitch plane oscillations after 136 sec attributed to pitch-rate feedback loop. A similar but larger amount than with S-01 1053 (oxidizer vent nullifier problem) noted. All systems performed to launch, boost, and inject the S-01 into near polar orbit under controlled attitude and in a condition suitable to effect recovery. | Azimuth: 176 deg<br>Altitude: 140.2 nm<br>Velocity: 25,780 fps<br>Inclination: 82.87 deg<br>Eccentricity: .0806<br>Period: 94.1 min<br>Perigee: 157.7 nm<br>Apogee: 436.2 nm |
| 14<br>445936-54 | 1056/237 | 4 | 8-18-60<br>1257:08<br>PDT | Yes | AEF. Yes - first successful air recovery. | AFL beacon and optical tracking lights restored. Continued use of gas jet spin system on payload. | Liftoff on first countdown. Ascent trajectories, and injection velocity within specifications. Indicated attitude instability during orbital passes 1 and 2. Satellite stabilized by pass 4, sharply reducing control gas consumption. Capsule recovered [illegible] aircraft. | Azimuth: 172.4 deg<br>Altitude: 120.4 nm<br>Velocity: 26,136 fps<br>Inclination: 79.65 deg<br>Eccentricity: 0.056<br>Period: 94.54 min<br>Perigee: 119.1 nm<br>Apogee: 502.5 nm |
| 15<br>445936-58 | 1058/246 | 5 | 9-13-60<br>1513:39<br>PDT | Yes | AEF. No | Similar to FTV-1056 | Launch successful on first countdown. Liftoff abnormal in that S-01 umbilicals ejected before actual liftoff. SLV-2 boost normal. SLV-2 oscillation noted. Momentary drop in thrust following S-01 engine ignition. Pneumatic attitude control system (gas jet) malfunction depleted control gas before recovery pass. Capsule located about 900 nm southeast of predicted impact point. Squall prevented sea recovery before capsule sank. | Azimuth: 175 deg<br>Altitude: 131.4 nm<br>Velocity: 26,025 fps<br>Inclination: 80.91 deg<br>Period: 94.2 min<br>Perigee: 131.4 nm<br>Apogee: 470.7 nm |
| 16<br>445936-61 | 1061/253 | 4 | 10-26-60<br>1226:00<br>PDT | No | AEF | First S-01 (Model 4608) | Launch on second attempt. Inoperative D-timer prevented programming of S-01 functions. No separation: combined vehicle followed ballistic trajectory after SLV-2 burnout. SLV-2 vernier and main engines cut off nearly simultaneously. SLV-2 structural oscillations during final 13 sec of boost. | |
| 17<br>445936-62 | 1062/297 | 5 | 11-12-60<br>1342:32<br>PST | Yes | AEF. Yes - air recovery | Similar to 1061 (S-01) | Satisfactory launch after initial cancellation on previous day due to umbilical connector J-[illegible] (D-timer) being separated from S-01 when the transporter-erector was lowered. All systems performed to launch, boost, and inject the S-01 into near-polar orbit under controlled attitude and in a condition suitable to effect recovery. Capsule recovery by aircraft at predicted point of descent. S-01 longitudinal oscillations prior to MECO similar to missiles 160, 244, and 253. | Azimuth: 172 deg<br>Altitude: 118 nm<br>Velocity: 26,370 fps<br>Inclination: 81.5 deg<br>Eccentricity: 0.058<br>Period: 96.16 min<br>Perigee: 116.5 nm<br>Apogee: 604.1 nm |
| 18<br>445936-63 | 1103/296 | 4 | 12-7-60<br>1220:59<br>PST | Yes | AEF. Yes - air recovery | S-01 with 8096 engine (dual start - not used on this launch). SLV-2 Block-2 engine (165,000 lb thrust) used for first time with S-01 vehicle. | Launch on first attempt. Liftoff and SLV-2 boost normal. Higher amplitude longitudinal oscillations (3.5 g) than with previous vehicles. All S-01 functions effected. Orbit close to that desired. Aerial capsule recovery after 48 passes (3 days), the longest time in orbit before initiating recovery. | Azimuth: 172 deg<br>Altitude: 126.3 nm<br>Velocity: 25,880<br>Inclination: 81.40 deg<br>Eccentricity: 0.0367<br>Period: 92.69 min<br>Perigee: 132.8 nm<br>Apogee: 437.3 nm |

# APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 19<br>[illegible] | [illegible] | 5 | [illegible] | Yes | [illegible] | [illegible] | [illegible] | Azimuth: [illegible]<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 20<br>[illegible] | [illegible] | 4 | [illegible] | Yes | [illegible] | [illegible] | [illegible] | Azimuth: 172 deg<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 21<br>[illegible] | [illegible] | 5 | [illegible] | Yes | [illegible] | [illegible] | [illegible] | Azimuth: 171.6 deg<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 22<br>[illegible] | [illegible] | 4 | [illegible] | No | [illegible] | [illegible] | [illegible] | Azimuth: 172 deg |
| 23<br>[illegible] | [illegible] | 5 | [illegible] | Yes | [illegible] | Similar to 22 | [illegible] | Azimuth: 172 deg<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 24<br>[illegible] | [illegible] | 4 | [illegible] | No | [illegible] | Similar to 22 | [illegible] | Azimuth: 172 deg |
| 25<br>[illegible] | [illegible] | 1 | [illegible] | Yes | [illegible] | [illegible] | [illegible] | Azimuth: 172 deg<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |

# APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 26<br>445936-09 | 1108/302 | 5 | 7-7-61<br>[illegible]<br>PDT | Yes | ABT. Yes - air recovery | Similar to 25 | Launch on first attempt. XLR-[illegible] thrust greater than predicted after slow engine start sequence. S-01 coupling P-[illegible] appeared to hang up on the vehicle at umbilical release with corresponding drop in battery-bus and regulated [illegible] power. Greater S-01 eccentricity and orbital period attributed to integrator error. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: 82.[illegible] deg<br>Eccentricity: 0.0[illegible]<br>Period: 95 min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 27<br>445936-10 | 1110/302 | 4 | 7-21-61<br>[illegible]<br>PDT | No | ABT | Similar to 25 | Liftoff on first attempt. Immediately after liftoff, a malfunction in the autopilot caused the vehicle to enter into divergent pitch oscillations. At T+57.2 sec, a -3 g moment which increased beyond calibration limit, was measured by the S-01 accelerometer, starting destruction of the vehicle. At T+60 sec, the vehicle was enveloped in flame, and at T+[illegible] sec the vehicle exploded. The cause of the malfunction is attributed to an open circuit in the XLR-[illegible] flight controller pitch-rate loop. | |
| 28<br>445936-11 | 1111/309 | 1 | 8-3-61<br>[illegible]<br>PDT | No | ABT. (recoverable)- No<br>ERP (nonrecoverable) | Similar to 25 but with XLR-[illegible] control system modifications for improved reliability. | Launch on second attempt. Liftoff and boost, guidance and engine cutoff were normal. All S-01 systems operated satisfactorily until T+[illegible] sec then loss of hydraulic pressure, possibly from a rupture on the high pressure side of the hydraulic pump, resulted in loss of pitch and yaw control and precluded orbital attainment. | |
| 29<br>445936-12 | 1112/303 | 4 | 30<br>8-31-61<br>[illegible]<br>PDT | Yes | ABT - Yes. Sea recovery. | Similar to 28 | Launch on second attempt. Liftoff, boost, and guidance normal. All S-01 systems operated to place vehicle in orbit. Hydraulic pressure T/M showed fluctuation for first 10 sec after ignition. Eccentric orbit attributed to improperly set [illegible] program. Capsule ejection, re-entry, and recovery described on page 33. | Azimuth: 172 deg<br>Altitude: 149 nm<br>Velocity: 25,5[illegible] fps<br>Inclination: 82.[illegible] deg<br>Eccentricity: .0[illegible]<br>Period: 91.5 min<br>Perigee: [illegible].7 nm<br>Apogee: [illegible].1 nm |
| 30<br>445936-13 | 1113/310 | 5 | 9-12-61<br>[illegible]<br>PDT | Yes | ABT-L - Yes. Aerial recovery on page 33. | ERP Kit [illegible] added. | Launch on first attempt. Liftoff, boost, and guidance normal. All S-01 systems operated to place vehicle in orbit. Potential problem resulted from a higher than predicted S-01 engine thrust level in that the required velocity gain sensed by the integrator occurred only 0.1[illegible] sec after the integrator had sent the shutdown signal before it was armed. If the integrator had sent the shutdown signal before it was armed, the engine would have burned to propellant depletion, causing excessive velocity. | Azimuth: 172 deg<br>Altitude: [illegible].7 nm<br>Velocity: 25,7[illegible] fps<br>Inclination: 82.7 deg<br>Eccentricity: .0[illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 31<br>445936-14 | 1114/[illegible] | 1 | 9-17-61<br>[illegible]<br>PDT | Yes | ABT-L - No. | ERP Kit [illegible] added. | Launch on first attempt. Liftoff, boost and guidance normal. All S-01 subsystems operated to place vehicle in orbit. Capsule ejection not effected due to loss of 400-cps, 3-phase power prior to recovery pass. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: 82.7 deg<br>Eccentricity: .0[illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 32<br>445936-15 | 1115/308 | 4 | 10-13-61<br>[illegible]<br>PDT | Yes | ABT-L - Yes. Aerial recovery on page 18. | No ERP Kit. | Launch on first attempt with but 1 min 3[illegible] sec hold time. S-01 pressurization and terminal count were run simultaneously to meet "window" requirements after an S-01 propellant transfer problem. Liftoff, boost, and orbital injection were all executed satisfactorily. Capsule reentry and air recovery were achieved on orbital pass 18. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: 81.6[illegible] deg<br>Eccentricity: .0[illegible]<br>Period: [illegible] min<br>Perigee: [illegible].5 nm<br>Apogee: [illegible] nm |
| 33<br>445936-16 | 1116/309 | 5 | 10-23-61<br>[illegible]<br>PDT | No | ABT-L | No ERP Kit. | Launch on first attempt. Liftoff and boost normal. S-01 hydraulic control malfunction caused a lofted trajectory and ultimately tumbling of the vehicle, precluding orbital injection. | |

## APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | [illegible] |
|---|---|---|---|---|---|---|---|---|
| 34<br>445936-17 | [illegible] | 1 | 11-5-61<br>[illegible]<br>PST | Yes | [illegible] - No. | [illegible] added. | Launch on second attempt (first attempt aborted due to improper SLV-2 engine sequence). Liftoff, boost, separation and coast normal. S-01 thrust phase normal except for engine shutdown. Shutdown occurred from propellant exhaustion instead of command due to the cutoff command signal preventing arming of the circuitry. Excessive injection velocity resulting caused an overly eccentric orbit. No recovery attempted due to loss of attitude control (gas valve malfunction) during pass 8. | Azimuth: 177 deg<br>Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible]<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 35<br>445936-18 | [illegible] | 4 | 11-15-61<br>[illegible]<br>PST | Yes | [illegible] - Yes. Aerial recovery. | Two radiometers added. | Launch on first attempt after 30 min of hold time, primarily for track schedules. Liftoff, boost, separation and coast normal. S-01 orbital injection velocity 113 fps low due to accelerometer-integrator error. Capsule air recovery effected on pass 18. | Azimuth: [illegible] deg<br>Altitude: [illegible]<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 36<br>445936-19 | [illegible] | 4 | 12-12-61<br>[illegible]<br>PST | Yes | [illegible] - Yes. Sea recovery on pass 64 (first 4-day recovery) | [illegible] | Launch on first attempt with 70 min of hold time for track schedules. Liftoff, boost, separation and coast normal. The S-01 engine exhibited higher than usual Isp and thrust. Intermittent fluctuation of hydraulic pressure noted during first 10 sec of S-01 burn. | Azimuth: 177 deg<br>Altitude: [illegible]<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 37<br>445936-20 | [illegible] | 4 | 1-13-62<br>[illegible]<br>PST | No. | [illegible] - No recovery | Rocketdyne Block II engine thrust increased from 167,000 to 170,000 lbs by changing propellant mixture ratio. First operational use of a 10-sec delay in terminal count to ensure readiness of various range support functions. | Launch on first attempt after hold in phase IV of terminal count to replace shear pin in elevator drive shaft. Liftoff, boost, flight control, and ground guidance normal. Separation on schedule, but an electrical transient during process resulted in loss of Link 2 telemetry power and a blown fuse in AC power bus to inertial reference package. S-01 ignition normal. No thrust vector control due to [illegible] power failure. One sec after S-01 thrust attainment, vehicle began to tumble and engine shutdown occurred 9 sec later. Velocity gain nil. Orbit not achieved. | |
| 38<br>445936-23 | [illegible] | 4 | 2-27-62<br>[illegible]<br>PST | Yes. | [illegible] - Yes. Aerial recovery on pass 65. | Power Supply Sub-system (PS/C) modified. | Successful liftoff achieved on first countdown. SLV-2 boost phase proceeded normally from liftoff through roll and pitch programs, and with correct ground guidance commands. Vehicle separation was normal. S-01 coast phase was stable and control gas consumption normal. S-01 propulsion exhibited normal start, thrust attainment, steady-state thrust characteristics, providing the desired impulse for attainment of a near-nominal orbit. Aerial recovery of the capsule successfully accomplished after 4 days in orbit (pass 65), the longest orbital period before capsule recovery yet achieved. | Azimuth: 177 deg<br>Altitude: [illegible]<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 39<br>445936-24 | [illegible] | 5 | 4-17-62<br>[illegible]<br>PST | Yes | [illegible] - Yes. | [illegible]. First use of pure nitrogen mixture control gas. | Successful liftoff achieved on first countdown. SLV-2 boost phase satisfactory, including the first planned "dog leg" in the booster trajectory to achieve an orbit inclination angle of [illegible] deg. All S-01 sub-systems performed satisfactorily except for abnormally large amount of post-shutdown impulse resulting from delayed closure of main fuel valve. Aerial recovery of the capsule successfully accomplished on [illegible] orbit. | Azimuth: 177 deg<br>Altitude: [illegible]<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |
| 40<br>445936-25 | [illegible] | 4 | 4-28-62<br>[illegible]<br>PST | Yes | [illegible] - No. Recovery attempt unsuccessful on pass 65. | [illegible]. Second use of pure nitrogen as control gas. | Successful liftoff achieved on first countdown. SLV-2 liftoff and boost normal. [illegible] channels of SLV-2 telemetry failed at liftoff. Second programmed "dog leg" and orbit inclination angle of 75 deg achieved. A second roll maneuver to compensate for roll induced by simultaneous pitch and yaw programs proved successful. Vehicle separation was normal. S-01 engine ignition was normal but a slight error in pitch attitude during the thrust interval resulted in higher than expected altitude and flight path angle. Orbital characteristics indicated all S-01 sub-systems were functioning properly. | Azimuth: 177 deg<br>Altitude: [illegible]<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible]<br>Perigee: [illegible]<br>Apogee: [illegible] |

correct date to 5-15-62

## APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 41<br>445936-35 | 1126/334 | 5 | ~~[illegible]~~ 5-15-62<br>1225:52.17<br>PST | Yes | ACF - Yes. Aerial recovery. | Similar to 1125. | Launch on first attempt. The countdown was delayed slightly in test 7 when difficulty was encountered in resetting the orbital timer. Four holds were also imposed for range clearance (trains), and 2 for abnormal 100 per cent LOX load indications caused by recycling of phase V. SLV-2 boost phase, separation, coast phase and orbital injection all satisfactorily accomplished. Control gas consumption appeared to be slightly above nominal but not excessive enough to endanger mission objectives. At time of telemetry signal loss, all vehicle sub-systems critical to the attainment of mission objectives were functioning properly. Successful capsule ejection and aerial recovery occurred on pass 48. | Azimuth: 172 deg<br>Altitude: 116.8 nm<br>Velocity: 25,692 fps<br>Inclination: 82.35 deg<br>Eccentricity: 0.0057<br>Period: 90.65 min<br>Perigee: 116.7 nm<br>Apogee: 162.8 nm |
| 42<br>445936-36 | 1128/336 | 1 | 5-30-62<br>1700:44.88<br>PST | Yes | ACF-1 - Yes. Aerial recovery. | Similar to 1126. | Launch on second attempt. First countdown aborted due to S-01 horizon sensor malfunction. SLV-2 boost phase satisfactory except for pitch flight path deviation. MECO occurred due to propellant depletion resulting in deficient velocity and altitude at coast apogee. A greater than expected consumption of control gas was the result of an extraneous roll torque caused by exhaust stack misalignment. All S-01 sub-systems functioned properly. Successful capsule ejection and aerial recovery occurred on 49th orbit. | Azimuth: 172 deg<br>Altitude: 120.1 nm<br>Velocity: 25,679 fps<br>Inclination: 74.16 deg<br>Eccentricity: 0.0128<br>Period: 90.06 min<br>Perigee: 125.7 nm<br>Apogee: 135.0 nm |
| 43<br>445936-37 | 1127/335 | 4 | 6-2-62<br>1730:07.75<br>PST | Yes | ACF - No. | Similar to 1128. DFR (direct-frequency-random) instrumentation for turbopump added to booster. | Launch on first attempt. Relatively few technical difficulties and no holds during countdown. SLV-2 boost phase satisfactory; orbit attained appears to be nearest to nominal of any SLV-2/S-01 configuration launched to date. S-01 sub-systems performed satisfactorily to attain mission objectives. Extraneous roll torque, apparently caused by exhaust stack misalignment, was again evident. Successful capsule ejection occurred on pass 65; however, recovery was not accomplished. | Azimuth: 172 deg<br>Altitude: 132.3 nm<br>Velocity: 25,715 fps<br>Inclination: 74.36 deg<br>Eccentricity: 0.0052<br>Period: 90.63 min<br>Perigee: 132.41 nm<br>Apogee: 157.95 nm |
| 44<br>445936-39 | 1129/339 | 4 | 6-22-62<br>1730:44.88<br>PST | Yes | ACF - Yes. Aerial recovery. | None. | Launch on first attempt. Failure of liftoff signal resulted in umbilical ejection by lanyard action. MECO occurred slightly later than predicted. Excessive expenditure of control gas to maintain control during thrust interval attributed to turbine exhaust misalignment. All other systems performed satisfactorily. Successful capsule ejection and aerial recovery on pass 32. | Azimuth: 172 deg<br>Altitude: 130.19 nm<br>Velocity: 25,637 fps<br>Inclination: 75.1 deg<br>Eccentricity: 0.00795<br>Period: 89.66 min<br>Perigee: 130.99 nm<br>Apogee: 195.51 nm |
| 45<br>445936-51 | 1151/340 | 1 | 6-27-62<br>1809:08.15<br>PST | Yes | ACF-1 - Yes. Aerial recovery on pass 42. | First S-01A. Modification included a horizon sensor; a velocity meter; pulse generating circuitry; on/off (nonproportional) control valves; dual-level pressure regulation system; a motor operated valve and orifices used for tank pressurization; presumed separation method. | Launch on first attempt. SLV-2 boost normal except MECO occurred from propellant depletion prior to transmission of guidance command. A slight deficiency in velocity was evident at coast apogee. Separation, coast, and orbital boost normal. Significant deviations from nominal trajectory conditions existed at orbital injection due to a velocity meter malfunction which permitted the S-01 engine to burn to propellant depletion. | Azimuth: 172 deg<br>Altitude: 130.6 nm<br>Velocity: 25,985 fps<br>Inclination: 76.06 deg<br>Eccentricity: 0.0346<br>Period: 93.68 min<br>Perigee: 130 nm<br>Apogee: 161.9 nm |
| 46<br>445936-38 | 1130/342 | 5 | 7-20-62<br>1356:39.51<br>PST | Yes | ACF-1 - Yes. Aerial recovery. | None. | Launch on second attempt. First countdown scrubbed due to S-01 helium leak. SLV-2 boost phase adequate. MECO occurred from propellant depletion almost simultaneously with ground guidance command. All S-01 sub-systems performed satisfactorily after separation to attain mission objectives. Orbit attained appears to be most precise of any SLV-2/S-01 vehicle to date. Successful capsule ejection and aerial recovery on 33rd revolution. | Azimuth: 172 deg<br>Altitude: 691,447 ft<br>Velocity: 25,715 fps<br>Inclination: 70.30 deg<br>Eccentricity: 0.00405<br>Period: 90.431 min<br>Perigee: 106.5 nm<br>Apogee: 212.8 nm |

## APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NUMBER AND LMSC REPORT NO. | VEHICLE SERIAL NO. | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 47<br>445936-31 | [illegible]<br>1131/347 | 4 | 7-27-62<br>1120:49.95<br>PDT | Yes | ARV-1 - Yes. Aerial recovery | First flight of booster model [illegible] and telemetry kit. | Launch on first attempt. SLV-2 boost phase satisfactory except pitch program appeared slightly deficient in pitchover rates. MECO occurred normally, separation smooth, and coast and orbital boost phases adequate. All S-01 vehicle sub-systems functioned properly to attain mission objectives. Capsule ejection and aerial recovery on 64th revolution. | Azimuth: 172 deg<br>Altitude: 475,000 ft<br>Velocity: 25,6[illegible] fps<br>Inclination: 71.09 deg<br>Eccentricity: 0.01405<br>Period: 90.715 min<br>Perigee: 177.8 nm<br>Apogee: 264.3 nm |
| 48<br>[illegible]-52 | 1152/344 | 1 | 8-1-62<br>1717:29.39<br>PDT | Yes | ARV-1 - Yes. Aerial recovery on 64th orbit. | Second S-01A configuration. Booster especially equipped to study 20-cps oscillations. | Launch successful on second attempt. Range priority forced cancellation of first countdown. Greater than expected thrust from SLV-2, resulting in slightly high pitch flight path angle. Control gas pressure transducer inoperative shortly after liftoff. Estimated above nominal consumption of control gas during S-01 thrust interval to counteract roll torque. Orbital performance reported as satisfactory. | Azimuth: 172 deg<br>Altitude: 480,000 ft<br>Velocity: 25,[illegible] fps<br>Inclination: 82.21 deg<br>Eccentricity: 0.0[illegible]<br>Period: 90.76 min<br>Perigee: 129.7 nm<br>Apogee: 242.2 nm |
| 49<br>[illegible]-53 | 1153/349 | 2 | 8-28-62<br>1820:34<br>PDT | Yes | ARV-1 - Yes. Aerial recovery | Similar to 1152. | Launch successful on second attempt. Failure of S-01 beacon antenna caused cancellation of first countdown. SLV-2 boost phase adequate and coast apogee conditions satisfied. Separation processes smooth followed by orbital injection. S-01 guidance errors resulted in errors in velocity, altitude, and elevation flight angle and the attainment of an orbit which differed considerably from the nominal. Orbital performance reported as satisfactory. Successful capsule ejection and aerial recovery occurred during 65th orbit. | Azimuth: 172 deg<br>Altitude: 125.4 nm<br>Velocity: 25,745 fps<br>Inclination: 65.7 deg<br>Eccentricity: 0.0160<br>Period: 90.32 min<br>Perigee: 111.1 nm<br>Apogee: 250.7 nm |
| 50<br>445936-32 | 1130/346 | 5 | 9-1-62<br>1139:08.53<br>PDT | Yes | ARV-1. No recovery. | None. | Liftoff on first countdown. SLV-2 boost and ascent normal. All S-01 systems operated to place vehicle in orbit. A [illegible] deviation noted in S-01 thrust but overall vehicle performance not affected. All sub-systems functioning properly at time of VHF telemetry fade to permit attainment of mission objectives. Orbital performance reportedly satisfactory. Capsule re-entry on pass 43. Recovery not accomplished. | Azimuth: 172 deg<br>Altitude: 188.6 nm<br>Velocity: 25,709 fps<br>Inclination: 82.81 deg<br>Eccentricity: 0.0277<br>Period: 94.43 min<br>Perigee: 186.6 nm<br>Apogee: 438.5 nm |
| 51<br>445936-33 | 1131/350 | 4 | 9-17-62<br>1644:12.07<br>PDT | Yes | ARV-1 - Yes. Surface recovery during 17th orbit. | None. | Launch on third attempt (first attempt cancelled due to S-01 integrator problem which precluded launching within time window; countdown scheduled for the following day cancelled before initiation due to payload problem; second countdown cancelled in last 10 sec. due to failure of S-01 liftoff system solenoid valve to actuate). Liftoff, boost, separation and coast normal. All vehicle sub-systems performed satisfactorily to provide adequate trajectory conditions for orbital injection. Orbital period attained approximately 2.8 min higher than nominal, indicative of an excess in injection velocity of approximately 220 fps and is attributed to an error in velocity measurement by accelerometer-integrator combination. At signal fade at VTS, all sub-systems were functioning properly to permit attainment of mission objectives. | Azimuth: 172 deg<br>Altitude: 120.9 nm<br>Velocity: 25,965 fps<br>Inclination: 81.76 deg<br>Eccentricity: 0.036<br>Period: 93.30 min<br>Perigee: 127 nm<br>Apogee: 416 nm |
| 52<br>[illegible]-54 | 1154/351 | 2 | 9-29-62<br>1634:10.50<br>PDT | Yes | ARV-1 - Yes. Aerial recovery during 65th orbit (Lifeboat). | None. | Launch on second attempt (first countdown cancelled when SLV-2 forward umbilicals disengaged prematurely). Liftoff, boost, separation, and coast normal. All vehicle sub-systems performed satisfactorily to provide adequate trajectory conditions for orbital injection; however, injection errors resulted as follows: 10 fps excess in velocity; 6 nm low in altitude; -0.2 deg elevation flight path angle; 0.5 deg in azimuth flight path angle. Orbital performance reportedly satisfactory except H/D horizon sensor failed subsequent to 20th revolution. | Azimuth: 172 deg<br>Altitude: 125 nm<br>Velocity: 25,320 fps<br>Inclination: 65.44 deg<br>Eccentricity: 0.0112<br>Period: 90.32 min<br>Perigee: 121.4 nm<br>Apogee: 239.4 nm |

## APPENDIX D LAUNCH DATA DIGEST (Continued)

| FLIGHT NUMBER AND TEST REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | GENERAL ASSIGNMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 53<br>[illegible] | [illegible] | 4 | 10-9-62<br>1135:38.77<br>PDT | Yes | [illegible] - Yes. Aerial recovery during 65th orbit. | None. | Launched on first attempt. Ground guidance lost at T+[illegible] sec. (No steering orders or discretes were transmitted.) SLV-2 airborne sub-systems performed satisfactorily. MECO occurred due to propellant depletion. Critical events signalled by airborne backups. No [illegible] time-to-fire or velocity-to-be-gained adjustments. [illegible] sub-systems functioned satisfactorily, but the specific impulse of the propulsion system was low. [illegible] shutdown due to fuel depletion. Significant trajectory errors at orbital injection (due to earlier loss of ground guidance). Orbital performance was satisfactory. Successful recovery accomplished. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| [illegible]<br>[illegible] | [illegible] | [illegible] | 10-26-62<br>[illegible]<br>PST | Yes | [illegible] - Nonrecoverable. | Modified [illegible]. | Launch on second attempt. First attempt aborted when payload telemetry system power supply failed. Liftoff [illegible] not properly generated. [illegible] umbilicals released by "fly-away." SLV-2 sub-systems performed satisfactorily. MECO occurred due to propellant depletion (planned). SLV-2 coast apogee conditions satisfactory. [illegible] sub-systems functioned satisfactorily. [illegible] engine shutdown from propellant depletion (also planned). Orbit attained satisfactory. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: 71.[illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 55<br>[illegible] | [illegible] | 4 | 11-5-62<br>[illegible]<br>PST | Yes. | [illegible] - Yes. Aerial recovery during 65th orbit. | None. | Launched on first attempt. Boost phase satisfactory. Propellant depletion shutdown. Separation smooth. Coast phase normal. [illegible] main engine provided proper orbital injection conditions. Orbital performance satisfactory. Successful capsule ejection and recovery on 65th orbit. | Azimuth: 172 deg<br>Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 56<br>[illegible] | [illegible] | 4 | 11-24-62<br>[illegible]<br>PST | Yes | [illegible] - Yes. Aerial recovery during [illegible] orbit. | None. | Launched on first attempt. Boost phase adequate. Separation and coast normal. [illegible] engine provided impulse for proper injection conditions. Orbital performance satisfactory. Successful capsule ejection and recovery on [illegible] orbit - longest orbital time to date. | Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 57<br>[illegible] | [illegible] | [illegible] | 12-4-62<br>1130:35.4<br>PST | Yes | [illegible] - No. Unsuccessful recovery attempt on [illegible] pass. | None. | Launched on first attempt. Liftoff and umbilical ejection normal. Booster telemetry failed at T+[illegible] sec. Propellant depletion MECO before attainment of required velocity. Coast apogee velocity and altitude significantly different than nominal. Significant deviation in [illegible] injection conditions and orbital parameters due to combination of SLV-2 velocity deficiency and [illegible] attitude error. Orbital performance reportedly satisfactory. Low perigee orbit necessitated early recovery attempt. Successful capsule ejection and re-entry on [illegible] pass. Damage during retrieval attempt resulted in loss of capsule. | Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |
| 58<br>[illegible] | [illegible] | 5 | 12-14-62<br>[illegible]<br>PST | Yes | [illegible] - Yes. Aerial recovery during 65th orbit. | None. | Launched on first attempt. Boost phase adequate to satisfy coast apogee criteria. Separation and coast normal. [illegible] engine provided impulse for near-nominal orbital injection. Flight path angle at injection slightly negative. Orbital performance reportedly satisfactory. Successful capsule ejection and aerial recovery on 65th orbit. | Altitude: [illegible] nm<br>Velocity: [illegible] fps<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: [illegible] min<br>Perigee: [illegible] nm<br>Apogee: [illegible] nm |

# APPENDIX D (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 59<br>8030564-57 | 1157/369 | 1 | 1-7-63<br>1309:49.06<br>PST | Yes | AET-L - Yes. Sea recovery during 65th orbit. | None | Launched on first attempt. Booster performance adequate to provide near-nominal coast apogee conditions. Separation and coast phase normal. S-01A engine provided impulse for near-nominal orbital injection. Flight path angle at injection slightly negative. S-01A orbital performance reportedly unsatisfactory due to horizon sensor malfunction prior to fifth orbit. Successful capsule ejection occurred on 65th orbit; however, re-entry occurred outside the planned area. The capsule was recovered from the water. | Altitude: 125 nm<br>Velocity: 25,765<br>Inclination: 82.74<br>Eccentricity: 0.0167<br>Period: 90.61<br>Perigee: 120 nm<br>Apogee: 259 nm |
| 60<br>445936-59 | 1159/354 | 5 | 2-28-63<br>1348:30.22<br>PST | No | AET - No recovery | Standard S-01A except for extension of forward rack to incorporate special payload. First SLV-2A booster. | Launched on second attempt. First attempt cancelled in task 12 because of difficulty with solid booster circuitry. One hold imposed (48 min) for S-01A oxidizer pump problem and range clearance. Solid booster No. 2 failed to ignite at liftoff and did not jettison. Data indicate solid motor No. 2 was not electrically connected to the booster and did not receive a firing signal. Loss of control occurred as a consequence of the failure of No. 2 to burn and resulted in flight termination and SLV-2A breakup at approximately T+127 sec. The S-01A vehicle apparently remained intact until T+219 sec. | |
| 61<br>445936-64 | 1164/360 | 4 | 3-18-63<br>1313:00.90<br>PST | No | AET (OPS) - No recovery | First vehicle to have airborne portion of BTL guidance system in S-01A vehicle. Second TAT (SLV-2A) booster. | Launched on first attempt. Forty-three min hold time. Liftoff normal. Booster objectives achieved. S-01A failed to attain orbit. Loss of pneumatic control shortly after separation due to an electrical malfunction (temporary short in safe/arm J-box). Lack of roll control during thrust interval prevented proper exercise of guidance. Premature shutdown of engine, which was indirectly associated with the electrical malfunction, precluded orbital attainment. | Altitude: 99.1 nm<br>Velocity: 24,813<br>Orbit conditions were not attained. |
| 62<br>445936-60 | 1160/376 | 5 | 4-1-63<br>1504:00.36<br>PST | Yes | AET-L - Yes. Aerial recovery on 49th orbit. | None. | Launch on first attempt. No holds imposed. Ninety min delay time. Liftoff normal. SLV-2 performance excellent. Near-nominal coast apogee conditions. S-01A subsystems functioned satisfactorily. Near-nominal trajectory conditions for orbital injection provided. On-orbit problems reported were: loss of lifeboat control gas evidenced by exponential decay in sphere pressure; malfunction of single-phase 400-cps inverter evidenced by low output during later revolutions. Despite these problems, successful capsule ejection and aerial recovery were affected on 49th orbit. | Altitude: 127.4 nm<br>Velocity: 25,734<br>Inclination: 75.36 d<br>Eccentricity: 0.0156<br>Period: 90.65<br>Perigee: 127.4 nm<br>Apogee: 256 nm |
| 63<br>8030427-11 | 1411/372 | 1 | 4-26-63<br>1212:57.07<br>PST | Yes * | AET-L - No recovery | None. | Launch on second attempt. First countdown cancelled because of inability to actuate S-01A lifeboat solenoid valve. Two holds imposed in final countdown for range clearance (26 min). SLV-2 boost phase satisfactory. Coast apogee target conditions satisfied. Sporadic SLV-2 yaw control during initial 40 sec of flight. Incorrect S-01A horizon sensor bias angle resulted in a +2.5 deg flight path angle and a >20 mile deviation in altitude at injection. Useful orbit not attained. Low perigee and positive flight path angle caused vehicle to re-enter during first revolution. | Altitude: 181.0 nm<br>Velocity: 25,257 f<br>Inclination: --<br>Eccentricity: 0.043<br>Period: 90.82 mi<br>Perigee: 25 nm<br>Apogee: 330 nm |

* No. Auth: History Report and Space Log

## APPENDIX D (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 64<br>445936-65 | 1165/364 | 5 | 5-18-63 | Yes | Similar to 1164. Recovery on 33rd orbit. | None. | Launched on fourth attempt. Two countdowns on 7 May and 8 May cancelled because of excessive upper air winds; one on 17 May cancelled because of questionable integrity of S-01A prime-card. Two holds in final countdown (23 min). Liftoff and boost phase normal. Nearly exact coast apogee conditions attained by SLV-2A. Guidance of the S-01A vehicle less accurate than predicted. Injection errors in altitude, flight path angle, and inertial velocity resulted in deviations from nominal orbit. After injection, removal of power to ground guidance beacon and application of power to payload (D-timer events) did not occur due to an apparent short. Attainment of orbital mission objectives were thus precluded. Vehicle recalled after 33 orbits. | Altitude: 75.25 r<br>Velocity: 11,830<br>Inclination: 74.61 d<br>Eccentricity: .02717<br>Period: 91.188<br>Perigee: 85.1 nm<br>Apogee: 282.0 n |
| 65<br>BO30564-61 | 1161/362 | 4 | 6-12-63<br>1658:38.03<br>PDT | Yes | GRD payload; recovery on 65th orbit | BTL missile-borne guidance system in S-01A vehicle. | Launched on second attempt. First countdown cancelled in terminal count because of difficulties with SLV-2A engine slew checks. No holds in final countdown. A large roll torque in SLV-2A within first second after liftoff. Departure azimuth in error by 5 deg. Trajectory such that it necessitated range safety to consider a destruct. Appropriate commands properly executed to correct error SLV-2A objectives subsequently achieved. S-01A subsystems functioned satisfactorily. Excessive amount of control gas consumed during thrust interval to overcome a roll torque. Orbital performance satisfactory. Aerial recovery on 65th orbit. | Altitude: 107.9 nm<br>Velocity: 25,765 f<br>Inclination: 81.83 de<br>Eccentricity: 0.01851<br>Period: 90.79 mi<br>Perigee: 106.6 nm<br>Apogee: 240.3 nm |
| 66<br>445936-66 | 1166/381 | 2 | 6-26-63<br>1737:26.16<br>PDT | Yes | Aerial recovery on 65th orbit | [redacted] | [redacted] | Altitude: 110.0 nm<br>Velocity: 25,732 fp<br>Inclination: 81.61 deg<br>Eccentricity: 0.01538<br>Period: 90.596 mi<br>Perigee: 110.45 nm<br>Apogee: 221.44 nm |
| 67<br>BO30427-12 | 1412/388 | 1 | 7-18-63<br>1700:10.58<br>PDT | Yes | ABT-L - aerial recovery on 65th orbit. | Similar to 1411 | Launch on second attempt. First attempt 17 July aborted - SLV-2 destruct receiver No. 2 abnormal. No holds in final countdown. Liftoff normal. Boost phase adequate. Abnormal control transients due to flight control problem during latter portion of boost. S-01A subsystems performed satisfactorily. An electrical short occurred at separation - no apparent affect except loss of link 2 T/M. Orbital performance reportedly satisfactory. | Altitude: 110.4 nm<br>Velocity: 25,717 fp<br>Inclination: 82.87 deg<br>Eccentricity: 0.0144<br>Period: 90.44 min<br>Perigee: 111.5 nm<br>Apogee: 216 nm |

# APPENDIX D, LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 68<br>445936-67 | 1167/382 | 2 | 7-30-63<br>1700:26.63<br>PDT | Yes | AST-L. Yes - Aerial recovery on 33rd pass. | Missile-borne portion of BTL guidance system installed in S-01A. | Launched on first attempt. No holds. Liftoff and umbilical ejection normal. MECO from propellant depletion. Slight velocity deficiency. Subsequent guidance commands and S-01A thrust compensated for the deficiency. Control gas consumption during thrust interval greater than expected - extraneous roll torque counteraction. Orbit obtained near nominal. Orbital performance of all subsystems reportedly satisfactory. Successful capsule ejection, re-entry, recovery on 33rd pass. | Altitude: [illegible]<br>Velocity: [illegible]<br>Inclination: [illegible] deg<br>Eccentricity: [illegible]<br>Period: 90.6[illegible] min<br>Perigee: 91.0 nm<br>Apogee: [illegible] nm |
| 69<br>B030564-62 | 1162/377 | 4 | 8-24-63<br>1729:58.13<br>PDT | Yes | AST-L. Yes - Aerial recovery on 65th revolution. | Missile-borne portion of BTL ground guidance in S-01A vehicle. | Launch on second attempt. No holds. First attempt cancelled at T-2.6 sec - defective relay in DAC AGE engine ignition circuitry. Liftoff time premature; otherwise liftoff normal. MECO from propellant depletion (planned). All ground guidance discretes properly transmitted and executed. Required coast apogee conditions provided by SLV-2A. Orbit obtained near nominal. Orbital performance of all subsystems reportedly satisfactory. Capsule ejection, re-entry and recovery on 65th revolution. | Altitude: 98.? nm<br>Velocity: 25,8?? fps<br>Inclination: 75.?? deg<br>Eccentricity: 0.01???<br>Period: 90.63 min<br>Perigee: 97.84 nm<br>Apogee: 240.35 nm |
| 70<br>445936-69 | 1169/394 | 5 | 8-29-63<br>1331:03.97<br>PDT | Yes | AST-L. Yes - recovery on 65th revolution. | None | Launch on first attempt. One hold imposed (32 min) because of intermittent operation of a pressure switch on launcher. Boost phase satisfactory; proper coast apogee conditions provided. Two S-01A anomalies evident during ascent - an excessive current transient at separation and a delayed engine shutdown. No damage from current transient; excess in injection velocity - gain from delayed shutdown. Orbital mission objectives satisfied. | Altitude: 163.4 nm<br>Velocity: 25,177 fps<br>Inclination: 81.84 deg<br>Eccentricity: 0.00???<br>Period: 90.80 min<br>Perigee: 163.8 nm<br>Apogee: 183.? nm |
| 71<br>445936-63 | 1163/383 | 2 | 9-23-63<br>1600:00.20<br>PDT | Yes | AST-L. Yes - on 49th revolution |  | Launch on first attempt; no holds imposed - no major difficulties encountered. Liftoff normal. Booster launch objectives satisfied. MECO by propellant depletion as planned; however, propellant utilization less than the ideal. S-01A subsystems performed satisfactorily to provide proper orbital injection conditions. Orbital performance reportedly satisfactory. Successful capsule ejection, re-entry and aerial recovery on 49th revolution. | Altitude: 94.85 nm<br>Velocity: 25,817 fps<br>Inclination: 74.9?? deg<br>Eccentricity: 0.01???<br>Period: 90.679 min<br>Perigee: 99.? nm<br>Apogee: ?37 nm |
| 72<br>B030758 | 1601/386 | 4 | 10-29-63<br>1319:03.72<br>PST | Yes | AST-L; yes - on fifth day | [redacted] | [redacted] | Altitude: 157.? nm<br>Velocity: 25,??? fps<br>Inclination: 89.91? deg<br>Eccentricity: 0.00???<br>Period: 90.8?? min<br>Perigee: 155.6 nm<br>Apogee: 191.6 nm |

# APPENDIX D, LAUNCH DATA DIGEST (Continued)

| FLIGHT NO. AND LMSC REPORT NO. | VEHICLE SERIAL NUMBER | PAD NO. | LAUNCH DATE AND TIME | ORBITAL ACHIEVEMENT | CAPSULE TYPE AND RECOVERY | VEHICLE CHANGES INCORPORATED | FLIGHT DESCRIPTION | INJECTION AND ORBITAL PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| 73<br>B030767 | 1171/400 | 2 | 11-9-63<br>1227:54.51<br>PST | No | ART-4; no | Booster non-TAT; standard SS-01A | Launched on first attempt. Two holds for trains - eight min. Boost phase unsatisfactory. Deterioration of flight control system at T+113 sec; complete loss of control at T+134 sec. Deterioration of flight control preceded by loss of main engine flame shield at liftoff. Exposure of control system wiring to excessive temperatures probably responsible for decay in control system performance. Separation due to structural failure. Both stages tumbled but remained basically intact. Evidence of damage in forward end of SLV-2 and payload separation from SS-01A. SS-01A subsystems normal until flight termination; remained in standby status after break-apart. | |
| 74<br>B030780 | 1172/406 | PALC 1<br>Pad 1 | 11-27-63<br>1315:40.13 | Yes | ART-4; no | Similar to 1171 | First launch of this configuration vehicle from PALC. Launch on first attempt. One hold for 12 min - range clearance. Error in countdown procedure resulted in omission of tank pressurization after SS-01A propellant loading. Boost phase satisfactory despite lower structural strength of SS-01A. Trajectory conditions near-nominal. Longer than predicted SS-01A engine burn duration because of low thrust. Mission objectives and near-nominal orbit attained. Link 1 telemetry not switched to orbital assignment after injection. Orbital performance reportedly satisfactory; however, attempted recovery on 81st pass unsuccessful. | Altitude: 99.6 nm<br>Velocity: 25,779 fps<br>Inclination: 69.95 deg<br>Eccentricity: 0.01577<br>Period: 90.17 min<br>Perigee: 98.1 nm<br>Apogee: 211.5 nm |
| 75<br>B030797 | 1168/398 | Pad 2 | 12-21-63<br>1345:41.7 | Yes | ART-4; ~~no~~<br>Yes; Aut [redacted] | [redacted] | [redacted] | Altitude 99.7 nm<br>Velocity 25,758 fps<br>Inclination 64.88 deg<br>Eccentricity 0.01407<br>Period 89.98 min<br>Perigee 99.5 nm<br>Apogee 200.6 nm |
| 76<br>VJ22 4-2-01<br>(AF Evaluation Office Report No.) | 1174/389 | 4 | 2-15-64<br>1338:23.10<br>PST | Yes | Successful Air recovery | LV-2A/SS-01A; BTL Guidance in SS-01A | Launched on first attempt. One hold for trains. Liftoff normal. MECO from guidance command. Stage II separation was normal; however, due to a slow shutdown of the stage II engine, the injection velocity was slightly greater than required | Alt 101.1<br>Vel 25,833<br>Incl 74.98<br>Eccen 0.0203<br>Period 90.86<br>Peri 101.09<br>Apo 218.39 |

| Flt No. | Vehicle Serial Number | Pad No | Launch Date | Orbital Achievement | Vehicle Changes Incorporated | Flight Description |
|---|---|---|---|---|---|---|
| 77 | 1175/396 | PALC 1<br>Pad 1 | 3-24-64<br>1422:48.52<br>PST<br>Capsule Type: AET-L<br>No recovery | No | LV-2A/SS-01A<br>BTL Guidance in SS-01A | First TAT vehicle from PALC; Launch or 1st attempt; 3 holds - 20 min total duration, for LV-2A gyro heater cycling. Reclycling BTL loop checks and for evaluation indicated SS-01 fuel leak; Boos performance sat factory; electr al power proble in SS-01A at VE resulted in complete loss o control during thrust interval; separation and ignitio normal; engine shutdown premature due to loss of contr which coupled with mis-dire tion of thrust, precluded orbit attainment. |
| 78 | 1604/395 | PALC 1<br>Pad 4 | 4-27-64<br>1623:43.55<br>PDT<br>Capsule Type:<br>No recovery | Yes | 16th TAT (LV-2A) | Launched on fir attempt. Very accurate orbit was attained. A SS-01A separatio an electrical overload of shor duration within the pyro distribution system, s part of the pyro bus power was permanently lost This precluded recovery, backup system, and research payload operations. The satellite was satisfactorily deactivated on orbit 7 and reactivated on pass 246. Power depletion occurred at Orbit 359. |

| | |
|---|---|
| Program 162 Vehicles Launched: | 78 |
| Vehicles Orbited: | 61 |
| Capsules Recovered:* | 40 |
| Air | 35 |
| Sea: | 5 |

* Four payloads, three of which orbited, were nonrecoverable types.